

ANNUAL REPORT

July 2023 – June 2024



Bangladesh Atomic Energy Commission

ANNUAL REPORT

July 2023 – June 2024

EDITORIAL BOARD

Chief Editor

Dr. Roksana Huque

Members

Ruseli Khan

Maruf Hossen

Md. Nur Alam

Bangladesh Atomic Energy Commission

Acronyms

AAS	Agricultural Advisory Society/Atomic Absorption Spectroscopy
AERE	Atomic Energy Research Establishment
AFSI	Agriculture and Food Systems Institute
ASME	American Society of Mechanical Engineers
ASNC	American Society of Nuclear Cardiology
AUI	Amity University of India
BAEC	Bangladesh Atomic Energy Commission
BAERA	Bangladesh Atomic Energy Regulatory Authority
BAS	Bangladesh Academy of Sciences
BCIL	Biotech Consortium India Limited
BCS	British Computer Society
BCSSGAI	British Computer Society Specialist Group on Artificial Intelligence
BEIS	Bangladesh Electronics and Informatics Society
BES	Bangladesh Entomological/Endocrine Society
BFSA	Bangladesh Food Safety Authority
BIM	Bangladesh Institute of Management
BMPA	Bangladesh Medical Physics Association
BNCDF	Bangladesh Non-Communicable Diseases Forum
BSMMU	Bangabandhu Sheikh Mujib Medical University
BSU	Bangladesh Society of Ultrasonography
BTF	Bangladesh Trade Facilities
BTS	Bangladesh Thyroid Society
CUET	Chittagong University of Engineering & Technology
DGHS	Directorate General Health Service
DMCH	Dhaka Medical College Hospital
FAO	Food & Agricultural Organization
FEES	Faculty of Earth & Environmental Science
FNCA	Forum for Nuclear Cooperation in Asia
GSB	Geological Survey of Bangladesh
IAEA	International Atomic Energy Agency
IPDIF	Integrated Professional Development Initiations Forum
JAEA	Japan Atomic Energy Agency
JMC	Jordanian Medical Council
KAERI	Korea Atomic Energy Research Institute
KOICA	Korea International Cooperation Agency
MI	Molecular Imaging
MoI	Ministry of Industries
MoPA	Ministry of Public Administration
MoST	Ministry of Science and Technology
NMS	New Medicine Society
SNMA	Society of Nuclear Medical Association
XRF	X-ray Fluorescence
ZSB	Zoological Society of Bangladesh

Contents

	Page
INTRODUCTION	1
I. PHYSICAL SCIENCES	2
ATOMIC ENERGY CENTRE, DHAKA	2
Chemistry Division	2
Electronics Division	36
Experimental Physics Division	40
Health Physics Division	49
Materials Science Division	66
Medical Physics Division	81
Non-Destructive Testing Division	84
Accelerator Facilities Division	89
Plasma Physics Division	96
ATOMIC ENERGY RESEARCH ESTABLISHMENT, SAVAR	98
CENTER FOR RESEARCH REACTOR	98
INSTITUTE OF NUCLEAR SCIENCE AND TECHNOLOGY	102
Radioisotope Production Division	102
Nuclear and Radiation Chemistry Division	104
Health Physics and Radioactive Waste Management Unit	107
Reactor Physics and Engineering Division	115
Tandem Accelerator Facilities Division	117
Isotope Hydrology Division	119
Reactor and Neutron Physics Division	122
INSTITUTE OF ELECTRONICS	126
General Electronics Division	126
Nuclear Electronics Division	128
Repair and Maintenance Division	130
Solar Cell Fabrication and Research Division	132
Robotics Instrumentation and Control Division	135
Very Large Scale Integration Technology Division	137
Production Division	137
INSTITUTE OF COMPUTER SCIENCE	138
Computer System and Network Division	139
Software Engineering Division	143

Nuclear Cyber Security Division	146
INSTITUTE OF ENERGY SCIENCE	150
INSTITUTE OF RADIATION AND POLYMER TECHNOLOGY	153
INSTITUTE OF NUCLEAR MINERALS	155
INSTITUTE OF NUCLEAR MEDICAL PHYSICS	163
BEACH SAND MINERALS EXPLOITATION CENTRE, COX'S BAZAR	164
ATOMIC ENERGY CENTRE, CHATTOGRAM	166
RADIOACTIVITY TESTING AND MONITORING LABORATORY, MONGLA	170
II. BIO-SCIENCES	171
INSTITUTE OF FOOD AND RADIATION BIOLOGY, AERE	171
Agrochemical and Environmental Research Division	171
Food Safety and Quality Analysis Division	173
Gamma Source Division	177
Insect Biotechnology Division	181
Microbiology and Industrial Irradiation Division	184
Radiation Entomology and Acarology Division	186
Cytology and Biocontrol Research Division	187
Veterinary Drug Residue Analysis Division	189
Plant Biotechnology and Genetic Engineering Division	191
Molecular Radiobiology and Biodosimetry Division	194
INSTITUTE OF TISSUE BANKING AND BIOMATERIAL RESEARCH, AERE	196
NUCLEAR MEDICINE	199
National Institute of Nuclear Medicine and Allied Sciences, Shahbag	199
Institute of Nuclear Medicine and Allied Sciences, Dhaka	206
Institute of Nuclear Medicine and Allied Sciences, Mitford	208
Institute of Nuclear Medicine and Allied Sciences, Chattogram	212
Institute of Nuclear Medicine and Allied Sciences, Mymensingh	217
Institute of Nuclear Medicine and Allied Sciences, Sylhet	219
Institute of Nuclear Medicine and Allied Sciences, Rajshahi	220
Institute of Nuclear Medicine and Allied Sciences, Dinajpur	221
Institute of Nuclear Medicine and Allied Sciences, Rangpur	223
Institute of Nuclear Medicine and Allied Sciences, Khulna	225
Institute of Nuclear Medicine and Allied Sciences, Barishal	226
Institute of Nuclear Medicine and Allied Sciences, Faridpur	228
Institute of Nuclear Medicine and Allied Sciences, Bogura	229
Institute of Nuclear Medicine and Allied Sciences, Cumilla	230

Institute of Nuclear Medicine and Allied Sciences, Cox's Bazar	231
Institute of Nuclear Medicine and Allied Sciences, Suhrawardy	232
Institute of Nuclear Medicine and Allied Sciences, Mohakhali	234
Institute of Nuclear Medicine and Allied Sciences, Jashore	237
Institute of Nuclear Medicine and Allied Sciences, Gopalganj	239
Institute of Nuclear Medicine and Allied Sciences, Satkhira	240
Institute of Nuclear Medicine and Allied Sciences, Pabna	241
Institute of Nuclear Medicine and Allied Sciences, Kustia	242
III. ENGINEERING AND GENERAL SERVICES	244
ENGINEERING DIVISION, BAEC HQ	244
ENGINEERING AND GENERAL SERVICES DIVISION, AECD	248
CENTRAL ENGINEERING FACILITIES, AERE	249
IV. INTERNATIONAL AFFAIRS DIVISION HQ	253
V. NUCLEAR POWER AND ENERGY DIVISION, BAEC HQ	255
VI. CONSTRUCTION OF ROOPPUR NUCLEAR POWER PLANT PROJECT (CRNPP)	256
VII. NUCLEAR SAFETY, SECURITY AND SAFEGUARDS DIVISION, BAEC HQ	261
VIII. PLANNING AND DEVELOPMENT DIVISION, BAEC HQ	261
IX. QUALITY MANAGEMENT DIVISION, BAEC HQ	268
X. SCIENTIFIC INFORMATION DIVISION, BAEC HQ	269
XI. HUMAN RESOURCES DIVISION, BAEC HQ	271
XII. SCIENTIFIC INFORMATION UNIT, AERE	273
XIII. TRAINING INSTITUTE, AERE	274
XIV. FINANCE AND BUDGET DIVISION, BAEC HQ	275
XV. SUPERVISION OF THESIS	276
XVI. INTERNATIONAL/NATIONAL PUBLICATIONS	288
XVII. PAPER PRESENTED IN SEMINAR/SYMPOSIUM/CONFERENCE/WORKSHOP	320

Introduction

Bangladesh Atomic Energy Commission (BAEC) was founded in Feb. 1973 through the promulgation of Presidential Order 15 (PO-15) of 1973 with the objective of promoting peaceful applications of nuclear energy in Bangladesh. Now-a-days BAEC emerged as the largest organization for scientific and technological research especially in the field of nuclear energy in this country. The essentially goal-oriented research and development (R&D) programmes in physical sciences, biological sciences, engineering and nuclear energy have been undertaken in the light of the overall need of the country. Thus the outcome of the activities can be directly contributed for socio-economic betterment in different sectors including food and agriculture, industry, power, health and environment protection.

Programmes of BAEC are chosen in a manner so that the priority, aspiration and needs of the country are amply reflected in their execution. Notable services of BAEC include modern nuclear medicine services to mass people, specially to the poorest section of the society, protection of public health and the environment through radioactivity monitoring of all imported food items, practice of safety culture against all kinds of radiation hazards, sterilization of medicine and medical equipment, food preservation, development of high quality polymer materials, chemical analysis of industrial products for QC purposes, chemical analysis of food and Environ. samples for protection against pollution, industrial NDT and material testing services etc. In the last few years, the BAEC has undertaken the challenge of implementing the Rooppur Nuclear Power Project (RNPP) as one of its highest priority task.

The R&D programmes of BAEC are carried out through its different institutes, centres. The laboratories of all the institute/centres are equipped with state-of the-art facilities. The major facilities include 3 MW BTRR, 3MV Tandem Accelerator Facility, 3MV Van de Graff Accelerator, Two Co-60 gamma irradiator, Central Radioactive Waste Processing and Storage Facilities, Nuclear apparatus and scanning devices in National Institute of Nuclear Medicine and Allied Sciences (NINMAS) and 21 Institute of Nuclear Medicine and Allied Sciences (INMAS) located at different district headquarters, Radioisotope Production Laboratory, Radioactivity Testing and Monitoring Laboratory, air particle monitoring facility, beach sand minerals processing pilot plant etc. Apart from R&D activities, the following divisions of BAEC are playing vital role in executing various programmes.

International Affairs Division (IAD): This division is playing a key role for maintaining liaison with many foreign countries and international organizations particularly International Atomic Energy Agency (IAEA) with a view of transferring the technology as well as developing human resources in the field of nuclear technology. This division is also in constant communication with IAEA in order to fulfill the country's obligation in matters related to Nuclear Safeguards and Non-proliferation of nuclear weapons. It also maintains liaison with other international bodies like RCA, Non-RCA, FTC, FNCA etc.

Planning and Development Division (PDD): This division is responsible for planning, development and execution of different ADP and special R&D projects.

Scientific Information Division (SID): This division is responsible for selection, collection, processing and providing information to a wide range of stakeholders concerned with the R&D activities and different services of BAEC. In addition, this division acts as an liaison between BAEC and the government on one hand and public, press etc. on the other hand.

Nuclear Safety, Security and Safeguards Division (NSSSD): This division is responsible for fulfilling the obligations rendered on operators under the signed international treaties, agreements, protocols and conventions related to safety, security, physical protection and safeguards of nuclear and radioactive materials.

Research and development (R&D) activities along with different service activities conducted during the period of July 2023 to June 2024 in the various fields of nuclear science and technology have been included in this report.

RESEARCH & DEVELOPMENT AND SERVICE ACTIVITIES

I. PHYSICAL SCIENCES

ATOMIC ENERGY CENTRE (AEC), DHAKA

Chemistry Division, AECD

Objective

The objective of this Division is to make significant contribution towards the scientific advancement and the socio-economic development of Bangladesh through different R&D programs of Bangladesh Atomic Energy Commission and unique and invaluable analytical services to potential individuals or group of entities from state level to end users.

Programme

The Chemistry Division of Atomic Energy Centre, Dhaka is recognized both nationally and internationally as one of the leading Research Hubs in the field of Chemistry with particular focus on Analytical Chemistry. As we have entered the new millennium, the demand for quality assured chemical analysis in samples of different description is ever increasing. Rising up to that demand, the laboratories in the Chemistry Division has been making significant contribution towards the scientific advancement and the socio-economic development of Bangladesh through different R&D programs and unique and invaluable analytical services to potential individuals or group of entities. Technical services in the form of chemical analysis of materials, analytical services for diagnostic purpose and consultant/expert services in special cases are provided regularly with care and utmost precision. The division has also been working in collaboration with other peer groups from universities, medical institutes and research organizations. In addition to that, it often provides academic and professional trainings to research students and professionals through specific programs. Along with all of these, the chemistry division is a regular participant in coordinated research programs under IAEA/RCA framework and a constant winner of research projects under MOST special grant program, particularly in the field of environmental pollution, nuclear analytical techniques in material analysis and environmental studies.

In brief, the major activities of this division fall under the categories-

1. Research and Development
2. Service
3. Thesis supervision
4. Paper presentation in seminar/symposium/conference
5. Publication
6. Attending seminar/symposium/conference/workshop
7. Training arrangement
8. Collaboration

The current activities of the chemistry division have been summarized below with their short details:

1. Research & Development

Advanced Analytical Chemistry

1.1 Assessment of Water Quality and Dissolved Organic Matter (DOM) Characteristics in the Blue Infrastructure of Dhaka City Using Fluorescence Spectroscopy

Y.N. Jolly, J. Kabir, S. Akter, K. M. Mamun and Nazifa Tabassum

This study was conducted to examine DOM components and determine their origins and fate in Dhaka city recreational water sources like Uttara, Ramna, Banani, Dhanmondi, Gulshan, Hatirjheel and Aftab Nagar lakes. pH, temperature, electric conductivity (EC), dissolved oxygen (DO), total dissolved solids (TDS), turbidity, Total Algae Phycoerythrin, Chlorophyll and salinity were tested in 31 water samples of the seven

lakes and found within the Bangladesh Environmental Conservation Rules standard (ECR 2023). Among the heavy metal studied concentration of Pb was found significantly high in water, whereas in soil samples Ca and Fe showed the highest concentration. This study identified fluorescence dissolved organic matters (fDOM) by three-dimensional excitation-emission matrix (3DEEM) spectroscopy and parallel factor analysis (PARAFAC). It showed elevated levels of aromaticity in Banani Lake with average value $10.008 \text{ L mg-C}^{-1} \text{ m}^{-1}$. The fluorescence index showed a minor contribution of microbes to the DOM in some lake water samples. The humification index reveals aquatic microbes and weakly humic defined homogeneous DOM dominated in all sampling points. The Biological Index showed autochthonous DOM productions were intermediate. The observed fluctuations in the properties of dissolved organic matter (DOM) in the lakes indicate that the origin and biogeochemical processes of DOM in this system could be influenced by human activities and climatic factors.

1.2 Investigation of Dissolved Organic Matter (DOM) Characteristics and Water Quality Across a Ramsar Wetland Tanguar Haor Using Fluorescence Spectroscopy

Y.N. Jolly, J. Kabir, S. Akter, K. M. Mamun and Fariha Ishrar Khan

The present study was focused on the dissolved organic matter (DOM) of the Tanguar Haor water using Fluorescence Spectroscopy (EEM-PARAFAC) analysis. X-ray Fluorescence analysis was used for measuring heavy metal concentration and YSI multiparameter for water quality such as temperature, salinity, turbidity, pH, DO, TDS, and EC etc. Parallel factor (PARAFAC) modelling on the sample fluorescence spectra confirmed the water DOM was mostly composed of three types of components such as protein-like, tyrosine-like and autochthonous fulvic acid having fluorescence peaks in the Peak T-region (270-280/296-340 nm), Peak TUV-region (225-230/304-336 nm), Peak A-region (260/448 nm) and Peak C (335/452 nm). The results indicated the dissolved organic matter in Tanguar Haor water likely originated from the microbial breakdown of organic matter, including the release of intracellular compounds during the decomposition of plant matter and organic detritus. Peak T's increased fluorescence intensity, raises the possibility that a protein-like component has a major role in the overall DOM. The mean dissolved organic carbon in water samples was notably lower ($2.51 \pm 2.44 \text{ ppm}$), attributed to natural processes such as decomposition of algae, aquatic vegetation, and microorganisms. The DOM indices (Fluorescence Index, Humification Index, and Biological Index) pointed toward the autochthonous or microbial origins. Furthermore, eight different elements (Cr, Fe, Co, As, Se, Sr, Hg, and Ni) were detected in Tanguar Haor water and found within the acceptable range of national and international standards except Hg.

1.3 Comparative Analysis of Seaweeds Reared with Oysters in Captive Environment

Y. N. Jolly, J. Kabir, S. Akter, K. M. Mamun and Sadia Afrin

Present study ascertained the comparison of the growth of different seaweeds and proximate and biochemical indices cultured with oysters in captivity, as well as pollution load index among seaweeds cultured in both captivity and open environment. To obtain the goal, the study was conducted in the Hatchery premises of Coastal Biodiversity, Marine Fisheries and Wildlife Research Centre, Cox's Bazar in 120 days time period. The red seaweed (*Gracilaria verrucosa*) and the green seaweed (*Ulva lactuca*) were co-cultured with the Indian backwater oyster (*Crassostrea madrasensis*). Co-culture of *Gracilaria verrucosa* was labeled as Treatment-1 (T1) and co-culture of *Ulva lactuca* was labeled as Treatment-2 (T2). All the three species were also cultured separately as Control. Three replications of all the treatments and controls were maintained. Seaweed and oyster samples were collected from Nunia Chara (21°28'19.5" N, 91°57'42.7" E) by the local farmers and harvesters for stocking in the experimental unit. All the culture tanks contained 100 liters of seawater. Uninterrupted aeration supply and artificial mild wave action were provided to facilitate optimum growth. LED lights were used above the experimental unit that provided $60 \mu\text{mol photons m}^{-2} \text{ s}^{-1}$ light intensity in the culture facility. Heavy metal pollution load index was calculated and analyzed from the seaweed samples, oyster samples and water from both captive and wild environment. The work is in progress.

1.4 Quantification, Characterization and Risk Assessment of Microplastics From Five Major Estuaries Along the Northern Bay of Bengal Coast

Yeasmin N. Jolly, Md Al- Mamun, Partho Banik, Md Anisuzzaman M. Belal Hossain

Microplastics (MPs) as hazardous contaminants has drawn the rapid attention of the general public due to

their omnipresence and adverse impacts on ecosystems and human health. This research focused on the presence, spatial distribution, morpho-chemical characteristics and ecological implications of MPs in water and sediment from five key estuaries (Meghna, Karnaphuli, Matamuhuri, Bakkhali, and Naf rivers) within the Bengal delta. Out of the five estuaries, the Meghna exhibited the least amount of MPs in both surface water (150.00 ± 65.62 items/m³) and sediment (30.56 ± 9.34 items/kg). In contrast, the highest occurrence of MPs was recorded in Karnaphuli river water (350.00 ± 69.22 items/m³) and Matamuhuri river sediment (118.33 ± 26.81 items/kg). Most identified MPs were fibers and < 0.5 mm in size in both water and sediment samples. Transparent MPs were dominant in both water (42.28%) and sediment (45.22%). Besides violet, red, blue, pink and green colored MPs were also observed. Various polymer types, including PE, PP, PET, PS, Nylon, EVA, and ABS, were detected, with PE being the dominant one. Based on the polymer risk index (PHI), the estuaries were classified as hazard level V, signifying a severe level of MP contamination. However, the potential ecological hazardous index (PEHI), potential ecological risk index (RI), and pollution load index (PLI) indicated moderate pollution levels. This study offers initial insights into the pollution caused by MPs in major estuaries of Bengal delta, which policymakers can utilize to implement suitable management strategies.

1.5 Commitment to Excellence: Analytical Chemistry Laboratory (ACL) Maintains Accreditation (ISO17025:2017) for Ensuring Quality Analytical Services of Heavy Metals in Different Matrix

T. R. Choudhury, M. N. E. Alam, M. A. Maksud, S. R. Khan, L. N. Lutfa, S. Sultana, S. B. Quraishi

The primary objective of the Analytical Chemistry Laboratory (ACL) in maintaining ISO 17025:2017 accreditation is to ensure the highest standards of accuracy, precision, and reliability in the measurement of heavy metals across various matrices. The Analytical Chemistry Laboratory is accredited according to ISO/IEC 17025 to analyze a diverse range of samples, including food products like milk, vegetables, feed, meat, and spices, as well as environmental samples such as water, soil, and sediment, and biological samples like urine. The Laboratory has been accredited since March 2015, maintaining a steadfast commitment to excellence and quality in its services. Over the years, the laboratory has continuously adhered to the highest standards of analytical precision and reliability, ensuring consistent and accurate results for its clients. This commitment was recently reaffirmed in 2024 with the successful completion of its third reassessment, highlighting the laboratory's ongoing dedication to maintaining its accreditation status. This rigorous reassessment process underscores the laboratory's unwavering adherence to international standards, enhancing its reputation for quality and reliability. As a result, clients can continue to trust that the laboratory's analytical services meet the stringent requirements of industry benchmarks, ensuring both the credibility and precision of their analytical data.

1.6 Microplastics (MPs) Unveiled: Recent Perspectives on Occurrence, Characteristics, Risk Assessment and Sustainable Management

T. R. Choudhury, M. N. E. Alam, M. A. Maksud, S. R. Khan, L. N. Lutfa, S. Sultana, M. Belal Hossain

Plastic waste contamination has emerged as a pressing global concern, with millions of tons of plastic being produced annually. Studies on MPs in the estuarine and coastal ecosystems of Bangladesh are very limited. The objective of this work is to comprehensively explore the prevalence and properties of microplastics, assess their potential risks to ecosystems and human health, and discuss strategies for their sustainable management. We conducted the first study on the abundance, distribution, characteristics, and risk assessment of microplastics in the sediment of Karnaphuli River estuary, and Kuakata sea beach in Bangladesh. Microplastic particles were extracted from sediments of 30 stations along the estuary from Karnaphuli River and 24 surface sediment samples were collected from the intertidal zone of the sea beach, Kuakata by density separation and then enumerated and characterized using a stereomicroscope and Fourier Transform Infrared (FT-IR) spectroscopy. In the collected sediment of the Karnaphuli River estuary, the number of MPs varied from 22.29 to 59.5, and in Kuakata it was 232 to 284 items kg⁻¹ of dry weight. The mean abundance was higher in the downstream and left banks of the estuary, whereas the predominant shape, color, and size of MPs were films (35%), white (19%), and 1–5 mm (30.38%), respectively in Karnaphuli River. Most of the MPs observed were colored (60%), and the rest were transparent (40%). Major polymer types were polyethylene terephthalate, polystyrene, polyethylene, cellulose, and nylon. The single value index, clearly demonstrated that all sampling sites were considerably polluted with microplastics (PLI > 1).

1.7 Revolutionizing Water Purification: Synthesis and Characterization of an Innovative Metal-Phenolic Nanocomposite Sorbent for Arsenic-Free Drinking Water

T. R. Choudhury, S. Alam, S. R. Khan, M. N. E. Alam, M. A. Maksud, S. B. Quraishi, B. A. Begum, M. A. Habib

Arsenic (As) contamination in drinking water poses a significant challenge globally, prompting extensive research into effective mitigation strategies. This study investigates a novel sorbent system designed for high arsenic binding through adsorption in solid media, employing a polyphenolic network with physical cross-linking using tannic acid and ZrIV ions. The resulting nano adsorbent molecules were characterized using x-ray diffraction analysis (XRD), energy dispersive x-ray spectroscopic (EDS), and Fourier transform infrared (FTIR) spectroscopy. Adsorption experiments were conducted under varying conditions such as pH, adsorbent dosage, and metal ion concentration. Optimal conditions were found to be at pH 7, 1 g/L adsorbent dosage, and 20 mg/L metal ion concentration, achieving an impressive removal efficiency of up to 95% within 90 minutes. The adsorption process followed a homogeneous monolayer chemisorption mechanism, as evidenced by the fitting of experimental data to the Langmuir isotherm model and pseudo-second-order kinetics. Considering the pervasive issue of arsenic contamination in groundwater and the associated health risks, this research sheds light on the nanostructure-dependent capabilities of the developed sorbent for arsenic adsorption applications. The findings not only demonstrate the efficiency of the proposed sorbent in removing arsenic from water but also contribute valuable insights into the adsorption mechanisms, providing a promising avenue for addressing arsenic contamination challenges in drinking water.

1.8 Synthesis of TiO₂-HDA Nanomaterial for the Removal of Radionuclide from Simulated Aqueous Waste Solution

M. N. E Alam, A. K. M. Ullah, M. M Hosen, T. R. Choudhury, M. A. Maksud, S. R. Khan, L. N. Lutfu, S. Sultana, S. B. Quraishi

In order to develop an effective process for the removal of radionuclides from contaminated waste aqueous solution (Simulated), a novel nanomaterial has been synthesized for this study. In this work, an organic-inorganic framework based nanomaterial of titanium dioxide modified with hexadecylamine (HDA) has been synthesized. The developed nanomaterials were applied to the simulated aqueous waste solution of several toxic metals and radionuclides in different concentration range. The synthesized NP was characterized by X-ray diffraction (XRD), scanning electron microscopy (SEM) with energy-dispersive X-ray diffraction (EDX), and Fourier-transform infrared spectroscopy (FT-IR). These methodological approaches demonstrated their capacity to synthesize crystalline and aggregated NP with a size average of 118 nm. The NP were found to have a significant surface charge which indicated the higher adsorption power. It was applied the simulated waste solution by varying pH, temperature, concentration of adsorbent and adsorbant, and contact time. The optimization of all the controlling parameters and adsorption mechanism with efficiency now under study.

1.9 Selectivity of Sol-Gel and Hydrothermal TiO₂ Nanoparticles towards Photocatalytic Degradation of Cationic and Anionic Dyes

M. N. E Alam, M.Y. Ali, T. R. Choudhury, M. A. Maksud, S. R. Khan, L. N. Lutfu, S. Sultana, M. H. Rahman

Titanium dioxide (TiO₂) nanoparticles have been extensively studied for catalyzing the photo-degradation of organic pollutants, the photocatalyst being nonselective to the substrate. We, however, found that TiO₂ nanoparticles prepared via the sol-gel and hydrothermal synthetic routes each possess a definite specificity to the charge of the substrate for photodegradation. The nanoparticles were characterized by SEM, FTIR, XRD, TGA, and UV-visible spectra, and the photocatalytic degradation under UV-B (285 nm) irradiation of two model compounds, anionic methyl Orange (MO) and cationic methylene blue (MB) was monitored by a UV-visible spectrophotometer. Untreated sol-gel TiO₂ nanoparticles (Tsg) preferentially degraded MO over MB (90% versus 40% in two hours), while after calcination at 400 °C for two hours (Tsgc) they showed reversed specificity (50% MO versus 90% MB in one hour). The as-prepared hydrothermal TiO₂ nanoparticles (Th) behaved in the opposite sense of Tsg (41% MO versus 91% MB degraded in one and a half hours); calcination at 400 °C (Thc) did not reverse the trend but enhanced the efficiency of degradation. The study indicates that TiO₂ nanoparticles can be made to degrade a specific class of organic pollutants from an effluent facilitating the recycling of a specific class of pollutants for cost-effective effluent management.

1.10 Enhanced Chromium (VI) Removal: A Remediation Study Employing Nano Zero-Valent Iron Supported By Sawdust

T. R. Choudhury, M. N Alam, M. A. Maksud, S. R. Khan, L. N. Lutfu, S. Sultana, M. Nurnabi

The rapid expansion of industry leads to the emission of heavy metals into the environment, posing a significant global concern presently. This study aimed to develop a cost-effective and sustainable remediation method using nano zero-valent iron supported by sawdust in removing chromium (VI) from contaminated environments. Sorption experiments were conducted using a composite material consisting of supported nano zero-valent iron on sawdust, designated as NZVI/SD. The NZVI/SD composite was prepared through a two-step process involving the impregnation of sawdust with ferrous sulfate, followed by a chemical reduction using Sodium borohydride (NaBH_4). The adsorbent was characterized with the help of Scanning Electron Microscopy (SEM), Energy Dispersive X-ray analysis (EDX), X-Ray Diffraction analysis (XRD), Fourier Transform Infrared Spectroscopy (FTIR) and chemical test. The adsorption characteristics have been investigated under various conditions, including different pH values, adsorbent dosages, initial metal ion concentrations, contact times, and varying temperatures. The optimal conditions for employing NZVI/SD for the removal of Cr(VI) were observed at a pH of 3.0, an adsorbent dosage of 0.5 g/L, an initial metal ion concentration of 61.45 mg/L, a contact time of 180 min, and a temperature of 50 °C. Sorption of Cr(VI) on NZVI/SD followed Langmuir Isotherm model. The maximum monolayer sorption capacity on NZVI/SD was 39.8 mg/g at 298 K temperature (equilibrium pH of 3.0) estimated from the Langmuir isotherm. Kinetics and thermodynamic studies on the sorption of Cr(VI) on NZVI/SD were done to understand the sorption mechanism.

1.11 Characterization and Application of Synthesized Calcium Alginate-Graphene Oxide for the Removal of Cr^{3+} , Cu^{2+} and Cd^{2+} Ions from Tannery Effluents

T. R. Choudhury, S. Ahmed, M. N. E Alam, M. A. Maksud, S. R. Khan, L. N. Lutfu, M. Nurnabi

Environmental sustainability has gained acceptance to achieving the goal of a secure ecosystem with a reliable management system. Heavy metal remediation of aqueous streams is of special concern due to the intractability and persistence in the environment. The objective of this study is to synthesize and characterize a novel calcium alginate-graphene oxide composite and evaluate its efficiency in removing Cr^{3+} , Cu^{2+} , and Cd^{2+} ions from industrial waste water. Calcium Alginate-Graphene oxide (CA-GO) composite has been synthesized for the adsorption of heavy metals including Cr^{3+} , Cu^{2+} , and Cd^{2+} ions from tannery effluents. Graphene oxide is prepared from commercial graphite powder and reacted with sodium alginate and calcium chloride to form the beads of CA-GO composite. The developed composite was characterized by FTIR, elemental analysis, SEM, XRD analysis, and Raman spectroscopy. Moreover, the effect of pH, adsorbent dosage, contact time, and initial concentration of metal ions on the adsorption capacity were investigated through batch experiments. At a $\text{pH} > 3.0$ (pH_{zpc}), the carboxyl group of CA-GO was deprotonated to make the surface negatively charged and facilitate metal adsorption. The optimum pH and maximum adsorption capacity of CA-GO for removal of Cr(III) , Cu(II) , and Cd(II) were 4.5, 6.0, and 7.0, and 90.58, 108.57, and 134.77 mg g^{-1} , respectively. The kinetics, adsorption isotherms, and thermodynamics were studied to determine the adsorption mechanism. The kinetic of adsorption adopted the second-order model. Thermodynamic parameter was calculated and the adsorption process was determined to be exothermic and spontaneous at room temperature. The developed composite has been efficaciously applied for the removal of metal ions and pollution from real tannery effluents.

1.12 Effect of Changing Climatic Conditions on The Bioavailability and Potential Mobility Trend of Metals from Sediment of Meghna Estuary

S. Hossain; M.S Rahman S. Sultana, T. Hamid; K. M. Mamun; J. Kabir; S. Akter; Y. N. Jolly

The study focused on the effect of climate change on the bioavailability and potential mobility trend of metals from sediment of the Meghna Estuary. Sediment samples were collected from four points around Hatiya Island, an offshore island in the northern Bay of Bengal. Heavy metals are found in various forms due to their binding to soil/sediment constituents. The study used a three-step BCR sequential extraction method to measure potential mobile fractions, chemical speciation, potential mobility, and bioavailability of metals under natural conditions at three different temperatures (10°C, 25°C & 45°C) set-up. Bio-available phases of the metals in sediment are water soluble, ion exchangeable, and carbonate bound. A three-step sequential

extraction method was applied, and leachate was measured to determine the metal / metalloid content in each fraction using ICP-OES. Also, physicochemical parameters were determined using a multiparameter. Total organic matter content is calculated by loss on the ignition test. The leaching behaviour of arsenic showed that the mobility is higher under high temperatures and very low (45°C & 10°C) temperatures than normal temperature of 25°C. So, the rapid climate change condition significantly affects the mobility and bioavailability of arsenic (As) from sediment to the environment. This work is in progress.

1.13 Phytosynthesis of Silver Nanoparticles (AgNPs) Using *Ziziphus Mauritiana* Leaf Extracts: Optimization of Extraction and Synthesis

A. R. M. Tareq, M. Fahim Ehasan, Ronia Sultana, A. K. M Atique Ullah, A.K. M. F. Kibria and M. Shajahan

The objective of the present study is to optimize the extraction of *Ziziphus mauritiana* leaf and the synthesis of silver nanoparticles (AgNPs). *Ziziphus mauritiana* leaf extracts were used in the synthesis of silver nanoparticles as capping and reducing agents. Water, methanol, ethanol, acetone and DMSO were used for leaf extraction applied by Soxhlet extractor. The variation and the extent of the phytochemicals extraction efficiency of those solvents understood clearly. Variation of the concentrations of silver nitrate (AgNO_3) solution, temperature and reaction time were obtained in controlling the synthesis of AgNPs. Ethanolic leaves extract of *Ziziphus mauritiana* were used for the synthesis of silver nanoparticles. The optimum conditions for silver nanoparticles synthesis were found to be 5mM silver nitrate (AgNO_3), 70°C and a pH of 9. Fourier Transform Infrared (FT-IR) Spectrophotometry was used to identify the functional groups in *Ziziphus mauritiana* leaf extracts. Successful phytosynthesis of silver nanoparticles (AgNPs) was confirmed using UV-Visible Spectrophotometry that recorded the Surface Plasmonic Resonance (SPR) peak at around 420nm. X-ray diffraction (XRD), Dynamic Light Scattering (DLS), energy dispersive X-ray (EDX) spectrometry, and transmission electron microscopy (TEM) analyses were carried out to understand the successful generation of AgNPs and their substantial existence, elemental composition, hydrodynamic diameter, surface morphology and crystalline phase.

1.14 Assesment of Chlorinated Phenols: 2, 4, 6-Trichlorophenol in Atmospheric Fine Particulate Matter of Dhaka City Using GC-FID

R. Sultana, M.A. Hossen, M. F. Ehasan, A. K. M. A. Ullah and A. R. M. Tareq

The objectives of the present work were to assess the importance of photochemical transformation of chlorinated phenols in the atmosphere under the influence of sunlight. Under this research we tried to assess the levels of concentration of 2, 4, 6-trichlorophenol in atmospheric fine particulate matter of Dhaka city. Total fourteen (14) $\text{PM}_{2.5}$ air sample were collected from Dhaka University area (Dhaka south) and Mirpur (Dhaka north) of Dhaka city, Bangladesh using air sampler. The samples of tree different seasons (Monsoon, Post monsoon and winter) from distinct location were collected. Newly developed method was applied for extraction and analysis of samples. Quartz filter papers were used for the collection of air samples. Newly developed method was applied for extraction and analysis of $\text{PM}_{2.5}$ samples. 1:1 mixture of ethyl acetate and dichloromethane (v/v) used for the extraction of 2, 4, 6-trichlorophenol. Gas Chromatography (GC) with flame ionization detector (FID) applied for the analysis of chlorinated phenol (2, 4, 6-trichlorophenol) in atmospheric fine particulate matter. The concentrations of 2, 4, 6-trichlorophenol in $\text{PM}_{2.5}$ of Dhaka University area and Mirpur area were found 0.06-12.05 ($\mu\text{g}/\text{m}^3$) and <DL-0.04 ($\mu\text{g}/\text{m}^3$). The average value of 2, 4, 6-trichlorophenol in monsoon, post monsoon and winter season in Dhaka University area are 0.07 $\mu\text{g}/\text{m}^3$, 0.10 $\mu\text{g}/\text{m}^3$ and 6.17 $\mu\text{g}/\text{m}^3$ respectively and in Mirpur area are 0.02 $\mu\text{g}/\text{m}^3$, 0.02 $\mu\text{g}/\text{m}^3$ and 0.03 $\mu\text{g}/\text{m}^3$ respectively. The average concentrations of 2, 4, 6-trichlorophenol in Dhaka north is lower than the concentrations in Dhaka south.

1.15 Analysis of Volatile Phenol and Some Phenolic Derivatives in the Surrounding Aquatic System of Rooppur Nuclear Power Plant

M. F. Ehasan, R. Sultana, A. K. M. A. Ullah and A. R. M. Tareq

The existence of phenols and phenolic derivatives in the aquatic system can be considered as the contamination of aquatic environment that can be attributed to natural and anthropogenic activities. Phenols and phenolic derivatives are considered to have toxic influence on humans. Our study goal is to identify the existence and assess the concentration levels of phenols and some phenolic derivatives surrounding aquatic

system of Rooppur Nuclear Power Plant (RNPP) site. Water samples from different selected points surrounding Rooppur Nuclear Power Plant were collected and preserved in amber bottle adding 10% CuSO₄ solution. About 100 mL of collected water sample was used for extraction of phenol and phenolic derivatives using dichloromethane (DCM) and ethyl acetate (EA) as an extracting solvent. GC-FID technique was applied for the analysis of phenol, 2-methyl phenol, 3-methyl phenol, 2-methoxy phenol, 2, 4-dimethyl phenol, catechol and 4-nitrophenol in water samples collected from the surrounding aquatic system of Rooppur Nuclear Power Plant. The concentrations of phenol ranges (0.021 -0.056) mgL⁻¹, 2-Methyl Phenols (0.000-0.014) mgL⁻¹, 3-methyl phenol (0.010-0.026) mgL⁻¹, 2-methoxy phenol (0.020-0.053) mgL⁻¹, 2,4-dimethyl phenol (0.003-0.014) mgL⁻¹, Catechol (0.012-0.263) mgL⁻¹, 4-nitrophenol (0.094-0.260) mgL⁻¹ respectively. Of the seven phenols 4-nitrophenol and catechol exist in highest concentrations in the surrounding water sample of Rooppur Nuclear Power Plant.

1.16 Investigation for Some Carcinogenic Polycyclic Aromatic Hydrocarbons (PAHs) in Surrounding Aquatic Environment of Rooppur Nuclear Power Plant (RNPP)

A. R. M. Tareq, M. F. Ehasan, R. Sultana and A. K. M. A. Ullah

Polycyclic aromatic hydrocarbons (PAHs) are widespread contaminants for environments are suspected human carcinogens and toxic to aquatic ecosystem. Generally, PAHs not exist in water in notable concentrations and their presence in water is an indication of source pollution. The objective of this study is to assess some of carcinogenic PAHs namely Naphthalene, Acenaphthene, Fluorene, Phenanthrene, Anthracene, Pyrene, Benzo(a)anthracene and Chrysene in the investigated area. A number of water samples were collected from different points around Rooppur Nuclear Power Plant. The collected samples were subjected to extract PAHs using dichloromethane and Ethyl acetate mixture by solvent-solvent extraction method. GC-FID technique was employed for the analysis. The analytical results revealed the concentrations of identified PAHs in the following range: naphthalene (0.018-0.034) mg/L, Acenaphthene (0.010-0.025) mg/L, Phenanthrene (0.010-0.057) mg/L, Anthracene (0.015-0.041) mg/L, Pyrene (0.002-0.041) mg/L, Benzo(a)anthracene (0.002-0.019) mg/L, Chrysene (0.001-0.005) µg/L, Fluorene (0.009-0.019) µg/L respectively. The minimum detection limit of the used GC-FID for PAH₈ was 0.001 mg/L. Recovery rates for the investigated compounds were varies from 65%-120%.

Food Chemistry

1.17 Contamination and Risk Assessment of Heavy Metals in Silver Pomfret (*Pampus argenteus*) in the Northern Bay of Bengal.

Y. N. Jolly, J. Kabir, S. Akter, K. M. Mamun, S. Hossain and Shabbir Ahamed Rony

The study was conducted on Silver Pomfret, collected from Mohipur, Khulna, and Cox's Bazar to identify the variations in the concentrations of heavy metals. Highest concentration of Ca (88.8) was found in Mohipur, while Khulna exhibited the lowest. Cox's Bazar showed the highest Cr (4.35) levels, whereas Khulna had the lowest. Mg (10.31) was found highest in Mohipur but Khulna having the lowest. Fe (80.11) content was highest in Khulna and lowest in Mohipur. Co (2.01) was highest in Khulna, followed by Mohipur and Cox's Bazar. Ni (1.09) levels were similar in Mohipur and Khulna but slightly higher in Cox's Bazar. Cu concentrations remained consistent across all three locations. Zinc (40.95) content was highest in Khulna, followed by Cox's Bazar and Mohipur. Se (9.3) levels were highest in Khulna, followed by Mohipur and Cox's Bazar. Rb concentrations were highest in Khulna, followed by Cox's Bazar and Mohipur. Sr levels were highest in Cox's Bazar, followed by Khulna and Mohipur. Hg was highest in Khulna, followed by Cox's Bazar and Mohipur. Pb content was highest in Mohipur, followed by Cox's Bazar and Khulna. Pollution load was very high in Cox's Bazar, medium in Khulna and low in Mohipur.

1.18 Heavy Metals Accumulation in Some Marine Fish Species from the Bay of Bengal, and Its Estimated Human Health Risks

Y. N. Jolly, J. Kabir, S. Akter, K.M. Mamun, Jobaida Akhter

This study provides information on the levels of thirteen trace and heavy metals (Pb, Cr, Cu, Zn, Mn, Fe, Hg, Ni, Co, Se, Rb, Sr and As) in the seven commercial fishes collected from Chittagong Fishery Ghat. Among the thirteen metals under this study, iron (Fe) showed the highest level of accumulation. The levels of Pb, Cr, Ni, As, Mn, Fe, Cu, Zn, Hg in the muscle tissue of the studied fish species were lower compared with the

permitted limits suggested by WHO and FAO. The mean value of THQ of all the species was below 1, for both adult and children, indicating no non-carcinogenic risk. Carcinogenic risk (CR) of Pb for adults and children were less than threshold limit (10^{-4}) and revealed that CR of Pb for all the adults and children were negligible. The CR of Cr in the fish species ranged from 10^{-6} to 10^{-5} in adult and children, which was acceptable. Cr, Mn, Cu, As, and Zn, originated from both natural and anthropogenic sources unremittably enter the aquatic environment. Tannery, textile, electroplating, mining, dyeing, printing, photographic and pharmaceutical industry effluents were the possible sources of heavy metal in the sea.

1.19 Assessment of Chromium in Poultry Feed and Products (Flesh, Liver, Bone & Gizzard) in Savar Sub-District Area.

Y. N. Jolly, J. Kabir, S. Akter, S. Hossain K. M. Mamun and Jakia Sultana

Three different chicken feed samples (Paragon, Teer, Narish broiler feed) and five chicken samples (for chicken flesh, bone, liver, and gizzard analysis) from five different location of Savar were collected for this study. A total of 26 samples were analyzed with one replicate of each sample. In analyzed chicken feed, Cr concentrations ranging from 3.653 to 9.43 ppm, with an average of 4.418 ppm. The average Cr concentrations in chicken flesh, bone, liver, and gizzard were found to be 3.41, 2.88, 5.24, and 4.17 ppm, respectively. In analyzed chicken samples the amount of chromium found in the following order-Liver>Gizzard>Flesh>Bone; indicating highest chromium accumulates in liver. The findings indicate the transfer and distribution of Cr from the feed to different chicken tissues. The analyzed Cr concentrations in chicken body parts were higher than the maximum permissible limit, 1.0 ppm set by the U.S. Environmental Protection Agency (USEPA). The target hazard quotient and target carcinogenic risk of the samples found within the acceptable limit, posing no future risk of carcinogenic effects. However, the study highlights the need for continuous monitoring and regulation of Cr levels in poultry products to ensure consumer safety.

1.20 Determining the Essential Element Profiles in some Foods Commonly Consumed During Pregnancy.

Y. N. Jolly, J. Kabir, S. Akter, S. Hossain K. M. Mamun, Ayesha Biswas, Sharmin Akter, Sakib Ahmed, Faria Rahman, Yasmin Akter, Shamea Akter, Sahida Akter, Abdul Ajij

Trace elements play significant role during pregnancy, as trace elements deficiencies have been documented to play a vital role in determination of the fetal outcome. This study mainly focused on the determination of 5 elements Fe, Zn, Cu, Mn, Se in 17 different samples of vegetables: Tomato (*Solanum lycopersicum*), Mistikumra (*Cucurbita moschata*), Baby corn (*Zea mays*) Jhinga (*Luffa aegyptiaca*). Poto (*Trichosanthes dioica*), Fruits: Mango (*Mangifera indica*), Bangi (*Cucumis melo*), Guava (*Psidium guajava*), Golden apple (*Aegli marmelos*), Fishes: Mola fish (*Amblypharyngodon microlepih*), Tengra (*Batasio fasciolatus*), Rui fish (*Labeo rohita*), Kajuli fish (*Ailia coila*), Shing fish (*Heteropneustes fossilis*), Baila (*Awaous grammepomus*), Poa fish (*Otolithoides pama*), Shol fish (*Channa argus*) those are usually consumed by pregnant woman. In this study, Fe was investigated as an ideal element, because the concentration of iron is present in all of our samples collected as like as vegetables fruits and fishes. Zinc is available mostly in fruits and fish sample. The availability of copper is average and mostly present in fish and fruits sample. The less detected elements are Mn and Se, which are found in very low concentration in the collected samples. This study supplies the valuable pieces of information about the metal contents in vegetables, fruits and fishes.

1.21 Heavy Metal Contamination Assessment in Dried Fishes Collected from the Local Market

Y. N. Jolly, J. Kabir, S. Akter, K.M. Mamun, A. K. Rupa and R. Hasan

A variety of twenty (20) commonly consumed dried fish samples were collected from different fish markets of Dhaka city (Karwan Bazar, Mohammadpur Krishi Market etc.) and were analyzed for their heavy metal contents (Fe, Se, Rb, Cr, Cu, Pb, Zn, As and Hg) using Energy Dispersive X-ray Fluorescence (EDXRF) Spectrometer. Concentration of all the metals were found lower than the safe value recommended by WHO Standard 2004, FAO/ WHO 1989, US FDA 1993 except Fe, Cu, Zn, and Hg. The metal pollution index, for all sample of fishes are quite high. Further works are in progress.

1.22 Determining the Trace/Toxic Element Profiles in Raw Milk Commonly Available in Different Areas of Bangladesh

S. Akter, Y.N. Jolly, J. Kabir, S. Hossain, K.M. Mamun, Evana Akter, SK. Kalimullah, Nurjahan

Rahman, Durjoy Kumar Baroy, Istiak Zaman Tanim and Md Masud Rana

The present study was conducted to determine the level of heavy metals (Ca, Cr, Mn, Fe, Co, Ni, Cu, Zn, As, Se, Rb, Sr, Hg, Pb) in cow's milk and evaluation of health risk due to consumption. Thirty (30) raw milk samples from 15 different districts of Bangladesh were considered for this study. Analysis of the data shows that the value of Ca in domestically produced milk is high compared to commercially produce milk. Due to the geological nature of the studied area, the concentration of these samples was not uniformly distributed with respect to the research location. The health risk index (HRI) of these elements in the milk samples were below 1, which is not harmful for human. The HI (hazard index) values for most of the elements in all milk samples were within the safe limit (<1.0) and suggested no risk.

1.23 Evaluation of Heavy Metal Contents in Spices Commonly Available in the Local Market of Savar, Bangladesh

S. Akter, Y. N. Jolly, J. Kabir, S. Hossain, K. M. Mamun, Israt Jahan Reshma

Evaluations of the concentration of heavy metals in locally available spices that are usually consumed by people living in Bangladesh are carried out in this study. Assessment of the potential human health risks, target hazard quotient, and target cancer risk for the local residents of Bangladesh were also studied. 14 different heavy metals were detected in the studied spices samples out of which Pb, Co, Cr As and Ni cause carcinogenic health effects. The estimated daily intake of K, Ca, Zn, Fe, Cu, Rb, Se, Sr, and Mn was also evaluated and compared with the recommended values of WHO, NASEM and EFSA, respectively. For non-carcinogenic analysis of spice brands, the Target Hazard Quotients (THQ) was estimated, and the relative positions of the values were found in the following order: B5>B2>B1>B3>Local Species >B4. All the estimated THQ values were less than 1, which refers to the fact that the ingestion of species won't cause non-carcinogenic health diseases. For the carcinogenic risk analysis of spices brands, the chronological estimated Target Cancer Risk (TCR) were B5>B3>B2>B1>B4> Local Species. All the TCR values were greater than 10^{-6} , which refers to the fact that ingestion of spices may cause carcinogenic health risk.

1.24 Toxic and Essential Elements in Fish Species of Different Rivers in Bangladesh and Assessment of Their Human Health Risks and Benefits

S. Akter, Y. N. Jolly, J. Kabir, S. Hossain, K. M. Mamun, Evana Akter and SK. Kalimullah

This study was carried out to quantify the concentration of heavy metals (Cr, Pb, Mn, Cu V, As, Ca, Zn and Fe) in different species of fish samples collected from the River Megna, Padma, Turag, Gorai, Balu, Shitalakshya, Brahmaputra, Rupsa, Nabaganga, Ichamati, Kaliganga, Gazikhali, Bongshai, Dhaleshwari, Bhairab, Chitra, Kumar, Atrai, Kholpetua and Buriganga s in Bangladesh and evaluation of health risk due to consumption of those fishes. The concentration of heavy metals were determined using X-ray Fluorescence (XRF) technique and the concentration in the fish samples were found in sequence of Fe > Zn > Mn > V > Cu > Pb > Cr > Ca > As respectively. The estimated daily intakes (EDI) of the studied metals from consumption of fish were also calculated. The estimated mean values of EDI for the heavy metals in fish samples can be synchronized as Fe > Zn > Mn > Cu > Pb > V > Cr > Ca > AS respectively. It was found that the EDI values for the examined fish samples were below than that of the recommended safe values.

1.25 Evaluation of Heavy Metals Associated Health Risk from Cooked Animal Protein Source (Egg, Fish, Chicken and Beef) in the Diet of Construction Workers in Bangladesh

S. B. Quraishi, A. Jahan, M. N. E. Alam, M. A. Maksud, S. R. Khan, L. N. Lutfu, T. R. Choudhury

Ingesting even trace amounts of toxic materials over an extended period can have devastating effects. Additionally, critical metals can have hazardous consequences when consumed in excess. Much research on the beneficial and harmful effects of food consumption on health has focused on necessary and toxic metal contents in foodstuffs in the last several decades. The assessment of the advantages and disadvantages of fried eggs, fish, chicken, and beef is of utmost importance in Bangladesh because these foods are regarded as crucial protein sources. The study was conducted to determine the presence of heavy metals, specifically arsenic (As), lead (Pb), chromium (Cr), and cadmium (Cd), in cooked samples of chicken, eggs, fish, and beef obtained from five restaurants frequented by construction workers in the Aftabnagar region. The laboratory examined a cumulative sum of 57 elemental samples containing Cr, As, Pb, and Cd. In the present study, the concentrations of Pb, Cd, Cr, As in representative samples of cooked Egg, Fish, Chicken & Beef were

determined and found in the range of Pb 0.30 ± 0.23 mg/kg egg, 0.44 ± 0.24 mg/kg fish, 0.52 ± 0.42 Chicken, 0.64 ± 0.25 mg/kg, Cd was found 0.02 ± 0.02 mg/kg egg, 0.10 ± 0.07 mg/kg Chicken, Cr was found 2.87 ± 2.68 mg/kg egg, 0.66 ± 1.05 mg/kg fish, 1.99 ± 4.02 mg/kg Chicken, 0.44 ± 0.60 beef respectively. The average levels of As in the chosen cooked samples were determined to be less than 0.08 mg/kg, which is below the detectable threshold. The results demonstrated that only Cr exceeded the maximum allowable concentration (MAC) for dietary food.

1.26 Metallic Echoes in the Bay: Assessing Heavy Metal Levels in Key Spiny Lobster Species from the Bay of Bengal, Bangladesh, and Their Implications for Consumer Health

T. R. Choudhury, T. Mustafa, S. Ahmed, M. R. Ahmed, M. N. E. Alam, M. A. Maksud, S. R. Khan, L. N. Lutfu, S. Sultana, D. R. Antu

Lobsters, esteemed for their culinary excellence and economic importance, are a significant export commodity in South Asian countries, especially in Bangladesh. Apart from being a delectable food source, lobsters play a pivotal role as nutritional staples for humans and act as vital biological indicators, reflecting the presence of pollutants in their aquatic habitats. This study focused on four spiny lobster species—*Panulirus homarus*, *P. ornatus*, *P. polyphagus*, and *P. versicolor*—collected from the Cox's Bazar, Teknaf, and St. Martin regions of the Bay of Bengal during the post-monsoon of 2023. Analyzing concentrations of heavy metals, including chromium, manganese, copper, zinc, cobalt, cadmium, lead, and mercury, across different body parts of the lobsters revealed higher metal accumulation in the carapace and cephalothorax. The hierarchical order of mean concentrations varied among species, with Zn, Cu, Pb, Mn, Cr, Cd, Co, and Hg showing distinct patterns. Notably, lead concentrations exceeded standard reference limits in the carapace of *P. homarus*. Utilizing the United States Environmental Protection Agency (USEPA) health risk model, the study assessed human health risks associated with metal concentrations. Fortunately, Zn, Cu, Cr, Mn, Co, Cd, and Hg levels were below the safe limits of FAO, WHO, and USEPA. Target hazard quotient (THQ), hazard index (HI), and target cancer risk (TR) calculations affirmed that lobsters from the studied region pose no carcinogenic risk to human health, reinforcing their safety for consumption. This study provides valuable insights into the safety of consuming lobsters from the Bay of Bengal, emphasizing their role as a sustainable and safe seafood source.

1.27 Microplastics Pollution in Salt Collected from Different Locations of Cox's Bazar District, Bangladesh

T. R. Choudhury, A. Rahman, M. N. Alam, M. A. Maksud, S. R. Khan, L. N. Lutfu, S. Sultana, A. Baki

In aquatic environments, microplastics (MPs) are pervasive which could have a considerable negative impact on the environment, organisms and pose a risk to human health. However, knowledge about the exposure and ecological risk of MPs in the coastal ecosystems of developing countries is limited. In this study, we analyzed salt samples from five commonly consumed processed and unprocessed sea salts of different commercial brands originated from 15 salt pans in Bangladesh to assess the abundance. This research has focused on the prevalence of microplastics in salt collected from 33 different locations in Cox's Bazar district. Through analysis, microplastic particles were identified in samples of locally sourced salt. The study describes MPs occurrence, distribution, and type from Cox's Bazar, Bangladesh. The maximum number of MPs in the 300-1500 μ m size class while the others fell into 1500-3000 μ m and 3000-5000 μ m. The most dominant color of analysed microplastic was black while red, blue, black, and transparent were also evident in the present study. Moreover, the dominancy in terms of shape, Fibers and foams was observed. Fourier Transform Infrared (FTIR) spectroscopy was done for the identification of the sample's chemical make-up. The findings of this study can be helpful for consumers, salt industries, and policymakers to be aware of or reduce MPs contamination levels in sea salts during production and consumption. This review summarizes the research progress on the characterization of microplastics, as well as their occurrence in salt samples from Cox's Bazar district.

Atmospheric and Environmental Chemistry

1.28 Quantification of Heavy Metal Level in Plants and Soils Collected from Agricultural Land beside Turag River

Y. N. Jolly, J. Kabir, S. Akter, K. M. Mamun and Farhan

Soil Samples were collected from two sides of Tongi Lake which is a part of Turag River. Heavy metals in soil followed the order of $\text{Fe} > \text{Ti} > \text{Mn} > \text{Zr} > \text{Sr} > \text{Zn} > \text{Rb} > \text{Cr} > \text{Pb} > \text{Cu} > \text{Co}$. The maximum and the minimum level of heavy metal in roots and leaves of potatoes, red amaranth and cauliflower were determined K (18880, 14180)-Cu(11.657, 19.592), K(40040, 21990)-Cu(23.144, 18.328), and(21240, 27150)-Cu(15.927, 11.376) mg/kg respectively. The Concentration of Co, Ni, As were below minimum detection limit (MDL) in plant samples. Estimated contamination factor (CF) values identified Cu, Co and Mn were at no pollution state, whereas Ti, Ca, Rb, Zr and Sr were at moderate pollution zone. For Zn, CF value indicated considerable pollution in this area. PLI values in every station was found below 1, thus indicated no significant pollution. No enrichment was found for Cr, Co, Cu and Pb, whereas EF values for Ca, Ti, Mn, Sr, Rb and Zr, indicating low enrichment and for Zn it was moderate enrichment.. Metal concentration is higher in plants grow in the polluted part than the plants grow in the unpolluted part and varied on species to species.

1.29 Heavy Metals in Afforested Mangrove Sediment from The World's Largest Delta: Distributional Mapping, Contamination Status, Risk Assessment and Source Tracing

Y. N. Jolly, J. Kabir, S. Akter, M.K. M Mamun Md Saifur Rahman

This study aims to assess seasonal and spatial variations, contamination status, ecological risks, and metal sources (Ni, Pb, Cr, Cu, Mn, and Zn) in human-afforested mangrove sediments in a deltaic region. Five sampling locations were sampled during dry and wet seasons. Heavy metal concentrations followed the order: $\text{Mn} > \text{Zn} > \text{Ni} > \text{Cr} > \text{Cu} > \text{Pb}$. Metal loads, except Cu and Pb, were higher during the dry season, aligning with national and international recommendations. Sediment quality guidelines, contamination factor, geo-accumulation index, enrichment factors, and pollution load index indicated uncontaminated sediment in both seasons. Potential ecological risk assessment showed low risk conditions in all sites. However, modified hazard quotient indicated moderate pollution risk from all metals except Pb. Analysis suggests anthropogenic sources, particularly evident near ship breaking yards in Sitakunda. While initially uncontaminated, ongoing metal influx poses a potential risk to mangrove ecosystems.

1.30 Delineation of Trace Metal Level in Fish Feed and Farmed Fish, Tilapia (*Oreochromis Mossambicus*) and their Consequences on Human Health

Y. N. Jolly, J. Kabir, S. Akter, K.M. Mamun and R. J. Rakib

The purpose of this research was to determine the possible health risks by identifying the trace metal content of feed and cultured tilapia fish in the Noakhali fish farms and Laxmipur/Central Coast district of Bangladesh. Commercial fish feed samples were collected from twelve randomly selected aquaculture farms on the central coast of Bangladesh. Trace metals, lead (Pb), manganese (Mn), zinc (Zn), copper (Cu), nickel (Ni), and chromium (Cr) concentrations in the edible muscle of tilapia fish and feeds were monitored by Energy Dispersive X-ray Fluorescence (EDXRF). Lead (9.37 ± 3.54 mg/kg) and Mn (7.94 ± 4.15 mg/kg) concentrations in tilapia were four and eight times higher than the WHO maximum levels. Trace metals varied in the examined fish and feeds, and trace metals in samples were higher than the FAO/WHO guideline values. The EDI values of Ni, Cu, Zn, Pb, Cr, and Mn from fish were lower than the MTDI value, suggesting that these metals might pose risks for prolonged consumption. The carcinogenic and non-carcinogenic health risks of consuming farm-cultured fish due to trace metals were relatively low and have less potential hazards to human health. This study will provide a baseline for monitoring trace metals in different edible aquatic organisms and recommends further investigation in different natural ecosystems and policy making.

1.31 Risk Assessment and Sources Apportionment of Toxic Metals in Two Commonly Consumed Fishes from a Subtropical Estuarine Wetland System

Y. N. Jolly, J. Kabir, S. Akter, K.M. Mamun and Md. Moudud Ahmed

This study investigates the concentrations of five toxic heavy metals (Pb, Hg, Zn, Cu, and Cr) and their potential health implications in two economically important fish species (*Otolithoides pama* and *Labeo bata*) from a subtropical estuarine wetland system (Feni estuary, Bangladesh). Muscle and gill samples from 36 individual fish were analyzed using energy dispersive X-ray fluorescence (EDXRF). The average quantities of heavy metals in both fishes' muscle followed the declining order of $\text{Zn} (109.41\text{--}119.93 \text{ mg/kg}) > \text{Cu} (45.52\text{--}65.43 \text{ mg/kg}) > \text{Hg} (1.25\text{--}1.39 \text{ mg/kg}) > \text{Pb} (0.68\text{--}1.12 \text{ mg/kg}) > \text{Cr} (0.31\text{--}5.82 \text{ mg/kg})$. Furthermore, Zn was found in the highest concentration within the gills of both species. While the levels of Cu, Zn, and Cr in the fish muscle were deemed acceptable for human consumption, the concentrations of Pb and Hg

exceeded the permissible limits (>0.5 mg/kg) for human consumption. According to the EDI values, individuals consuming these fish may face health risks as the levels of Zn, Cu, and Cr in the muscle are either very close to or exceed the maximum tolerable daily intake threshold. Nevertheless, the THQ and HI values suggested that both species remained suitable for human consumption, as indicated by THQ (<1) and HI (<1) values. Carcinogenic risk values for Pb and Cr, remained within permissible limits (10^{-6} to 10^{-4}). The correlation matrix and multivariate principal component analysis (PCA) revealed that Pb and Cr were primarily from natural geological backgrounds, whereas Zn, Cu, and Hg were from human-induced sources.

1.32 Heavy Metal Accumulation and Phytoremediation Potentiality of Trace and Heavy Metals in Some Selected Aquatic Plants from a Highly Urbanized Subtropical Estuary

Y. N. Jolly, J. Kabir, S. Akter, K. M. Mamun and Fatema Tanjim

This study involved collecting sediment and aquatic plant samples (*Acanthus ilicifolius*, *Typha elephantina*, and *Cynodon dactylon*) from a highly urbanized estuary to analyze metal concentrations in sediment, assess ecological risks, and explore the phytoremediation potential. The sediment metal concentrations were found in decreasing order of Fe > Ti > Mn > Rb > Zr > Zn > Sr > Cu > Co > As. Cumulatively, the pollution load index (PLI) values were close to 1 (0.845), indicating, that the study area is likely experiencing metal pollution. The Contamination Factor indicating a moderate degree of sediment pollution for Ti, Mn, Cu, Zn, and Rb. The Enrichment Factor (EF) values similarly showed moderate enrichment for these metals but Cu exhibiting the highest degree of enrichment. Ecological risk assessment highlighted the only metal, Cu, posing the greatest risk among the studied metals. In terms of phytoremediation potential, the bio-concentration factor (BCF) followed the decreasing order of *C. dactylon* > *A. ilicifolius* > *T. elephantina* for most metals, with low BCF values (<1) indicating low accumulator potential. However, the translocation factor (TF) values for Zn (1.464) and Rb (1.299) in *A. ilicifolius* species were greater than 1, indicating low accumulation potential but hyper-metabolizing capabilities, allowing the plant to accumulate metals in its aerial parts, making it effective for phytostabilization.

1.33 Evaluation of Heavy Metals in Soil, Sediment and Water Collected from Rupsha River and their Possible Health Risk Assessment

Y. N. Jolly, J. Kabir, S. Akter, S. Hossain, K. M. Mamun and Shahidul Islam

10 sampling sites of the Rupsha River were chosen for water and sediment sample collection. In addition, six (6) species of fish collected from the local fishermen of the same river. The mean concentrations of the metals in water samples followed the descending order as Fe > Al > Ti > Cu > Ni > Zn > Mn > Hg > Cr > Se > Cd > V > Pb > As. Similarly for sediment, the descending order was Al > Fe > Mg > Na > Ti > K > Sr > Mn > V > Cr > Zn > Pb > As > Co > Sc > Cd. And for fish, the descending pattern was Fe > Zn > Cu > As > Mn > Se > Hg > Ni > Cr > Pb > Co. The magnitude of pollution in water has been evaluated by Heavy Metal Pollution Index (HPI) and Heavy Metal Evaluation Index (HEI). While sediment pollution level has been evaluated by Pollution Load Index (PLI), Enrichment Factor (EF), Geo-accumulation Index (Igeo) and Correlation coefficient. And fish has been evaluated by Metal Pollution Index (MPI), Daily Intake of Metal (DIM), Health Risk Index (HRI), Target Hazard Quotient (THQ), Hazard Index (HI) and Target Cancer Risk (TR). Based on the results, it was concluded that the surface water of the Rupsha River is highly polluted with several metals. Sediment is highly polluted with Al and Fe and moderately polluted with Ti, Zn, V, Cr, Sr, Pb etc. Health hazard (HI) has been measured based on adult person standard and for fish, the estimated value of HI > 1; indicating high risk due to consumption of fish.

1.34 Spatial Distribution of Arsenic (As) and Associated Metals (Fe and Mn) in the Accreted Land and its Potential Pollution and Health Risks in the Greater Noakhali Coast Region, Bangladesh

Y. N. Jolly, J. Kabir, S. Akter, S. Hossain, K. M. Mamun and Tobarok Bhuiya

Energy Dispersive X-ray fluorescence (EDXRF) technique was used to analyze the concentration of the heavy metals (As, Fe, Mn). The study reveals that As, Fe, and Mn concentrations in the surface sediment samples varied from 0.1-5.162, 12,000-23,810, and 50.6-1,025.12 mg/kg respectively where As is lower than the average level of arsenic in some districts in Bangladesh but Fe and Mn are higher than southern coastal sediment of Bangladesh. Higher metal concentrations were found in the southern belt which is along the Meghna and small Feni River estuary. The result of the geo-accumulation index (Igeo) was found to be less than 0 for every metal, contamination factor (CF) and pollution load index (PLI) were less than the

contamination level which indicated an "unpolluted" state. Additionally, the potential ecological risk index (PERI) values directed that arsenic and associated metals posed low ecological risks. Moreover, no non-carcinogenic effects on human health were found solely by As, Fe, and Mn. Arsenic in sediment has no significant correlation with the other associated heavy metals, Fe and Mn have a moderate positive correlation.

1.35 Spatial Distribution of some Potentially Toxic Elements (PTEs) in the Surface Soil of the Coastal Area of Greater Noakhali

Y. N. Jolly, J. Kabir, S. Akter, S. Hossain, K. M. Mamun and Tazrian Mim

This study investigates the concentrations and spatial distribution of potentially toxic elements (PTEs) such as Cr, Mn, Ni, Cu, Zn, and Pb in the surface soil of the coastal area of Greater Noakhali, Bangladesh, which has been formed by the accretion of the Meghna River. 25 surface soil samples were collected and analyzed using Energy-Dispersive X-ray Fluorescence (EDXRF) spectrometry. The results revealed that the average contents (mg/kg) of heavy metal followed the order of Mn > Zn > Cr > Ni > Cu > Pb. A comparison of the mean concentrations of PTEs with the background values of the Upper Continental Crust revealed high concentrations of Zn at almost all the sampling stations. The primary sources of high Zn concentrations in these areas are likely runoff from agricultural activities (due to the use of zinc-containing fertilizers and pesticides) and domestic waste disposal. Spatial distribution mapping using ArcGIS indicated localized sources of contamination, with variations attributed to river flow, pollution sources, and physicochemical conditions. This study emphasizes the necessity of strict controls and continuous monitoring in order to reduce PTE pollution and protect the environment and public health in the area.

1.36 Spatial Variation of Heavy Metal in the Shipbuilding Operations along Rupsha River, Bangladesh.

Y. N. Jolly, S. Akter, J. Kabir, S. Hossain, K. M. Mamun and Md. Ahasanul Karim

The study aims to quantify and analyze the levels of Chromium (Cr), Manganese (Mn), Iron (Fe), Nickel (Ni), Copper (Cu), Zinc (Zn), Arsenic (As), Mercury (Hg), Lead (Pb), and Cadmium (Cd) of river sediments, in the vicinity of shipbuilding operations along the Rupsha River in Bangladesh. The average concentrations of metals were found to be 3.67 (Cr), 26.84 (Mn), 21876 (Fe), 16.03 (Ni), 22.96 (Cu), 13.96 (Zn), 1.30 (As), 6.86 (Hg), 3.41 Pb, and 21.82 (Cd) mg/kg respectively. The concentrations of Cr, Mn, Ni, As, Hg, Pb, and Cd substantially exceed both WHO and BDSW permissible limits, with Hg and Cd surpassing safe levels by over a thousand fold. These findings indicate severe heavy metal contamination, posing significant environmental and health risks. Spatial analysis reveals that proximity to shipbuilding activities correlates with higher concentrations of these metals, suggesting industrial operations as a primary source of pollution. The study underscores the urgent need for regulatory interventions and the implementation of pollution control measures to protect the Rupsha River ecosystem and public health. This research provides a critical baseline for future monitoring and remediation efforts in the region.

1.37 Impact of Radionuclides and Heavy Metals on the Environment Around the Coal-Fired Power Plants in the Southern Part of Bangladesh.

Y. N. Jolly, J. Kabir, S. Akter, S. Hossain K. M. Mamun and Asaduzzaman

The purpose of this research was to detect the toxic elements and radionuclides in soil samples of some specific areas near thermal power plants areas and around its rivers. 52 soils and 12 types of fishes were collected around the thermal power plant of Payra and Rampal. ²³⁸U, ²³²Th, and ⁴⁰K radionuclides and Mn, Cr, Hg, As, Pb, Cu metals are detected by High Purity Germanium (HPGe) detector and X-ray Fluorescence (EDXRF) respectively. In fish samples, the gamma activity concentration of ²³⁸U, ²³²Th, and ⁴⁰K were found to be 9.768 Bq/kg, 24.023 Bq/kg, 471.299 Bq/kg and 13.62 Bq/kg, 19.402 Bq/kg, 455.54 Bq/kg for Payra and Rampal thermal power plants, respectively. The average concentration of ²³⁸U, ²³²Th, and ⁴⁰K in the Payra and Rampal thermal power plants soil samples also determined 571 ppm, 2.63 ppm, 0.44% and 0.65 ppm, 2.48 ppm, 0.52%, respectively. In fish samples, the gamma activity concentration of ²³⁸U, ²³²Th, and ⁴⁰K were found to be 0.79 ppm, 5.91 ppm, 1.50% and 0.42 ppm, 4.77 ppm, 1.45% for Payra and Rampal thermal power plants, respectively. For Payra power plant, heavy metal concentration of Fe, Cu, Zn, Sr, Pb and As are 5.118, 44.938, 116.200, 122.264, 2.458 and 0.491 mg/kg, respectively and for Rampal power plant, heavy metal concentration of the respective elements were 4.261, 31.806, 107.315, 98.705, 1.020 and 0.413 mg/kg, respectively. In fish samples, heavy metal concentration for Mn, Cr, Hg, As and Pb were 4.585,

1.936, 1.0485, 0.41 and 0.828 mg/kg, respectively. The average radiological hazard, Metal Pollution Index (MPI), Health Risk Index (HRI) and Enrichment Factor (EF) analysis were carried out which were found within the range of world maximum limit.

1.38 Determination of Non-radiological Pollutant of Various Components of Rooppur Nuclear Power Plant Construction Area

Y. N. Jolly, J. Kabir, S. Akter and K. M. Mamun

A roadmap has been made for year around sample collection from the area of 30 Km radius around the Rooppur nuclear power plant (RNPP), their processing, preparation and analysis in the laboratory and reporting to the stakeholders. As per the roadmap, sample collection has begun from February 2021 for winter season. More than 160 samples including water, soil, sediment, vegetables, fish, beef, cow milk, grass etc. have been collected. Most of the samples have already been prepared and their analysis for the presence of the elements including but not limited to Pb, Cd, Cr, Ni, Cu, Fe, Mn, Zn, Co, Hg etc. is ongoing on a continuous basis. Planning for sample collection of next seasons is already underway while the report of analysis of some items like water and soil is ready to be delivered to the stakeholders. It's a monitoring program

1.39 Assessing and Improving the Sustainable Drinking Water Management System with the Effect of Climate Change in the Middle Part of the Bengal Delta

S. Hossain, M. S. Rahman, K. J. Fatima, K. M. Mamun, J. Kabir, S. Akter, Y. N. Jolly and B. A. Begum

17 potable water samples were analyzed to check the metal content (As, Fe, Mn, Pb, Ba, B, Zn, Zr, Sn, Sr, Se and Cd) using the ICP-OES technique of Kotchandpur thana, Jhenaidah district in the middle part of the Bengal delta. All the elements were found within the permissible limit of drinking water suggested by World Health Organization (WHO) and Bangladesh Water Development Board (BWDB) except Pb. In the wet season, the concentration of lead (Pb) ranged from 2.00 to 65.3 µg/L whereas in the dry season 0.40 to 27.60 µg/L. Among 17 samples, 13 water samples exceeded the WHO and BWDB permissible limit of drinking water for Pb concentration in the wet season, in contrast, 11 water samples showed elevated levels of Pb concentration in dry season. Even the deep groundwater showed a 5 to 6-fold higher concentration of Pb in the wet season. So, there is a clear change in the concentration of trace metals in potable water with seasonal variation and depth. Deep groundwater is not blindly safe to drink. These results should be considered as a serious issue for sustainable drinking water management in the Bengal Delta.

1.40 Assessment of the Current Pollution Conditions and Risk Assessment of the Shitalakhya River and Adjacent Groundwater Quality

S. Hossain; M.S. Rahman; A. Rahman; M. Khan; K. M. Ahmed; K. M. Mamun; J. Kabir; S. Akter; Y. N. Jolly

A total of 40 water samples were collected where 20 samples were from the Shitalakhya River and 20 samples were from river-adjacent groundwater along a 73 Km stretch of Shitalakhya River at 2-3 km intervals. This study analyzed 14 trace elements (Al, As, B, Ba, Cd, Cu, Mn, Ni, Pb, Sn, Sr, Ti, Zn, Zr) in both surface and groundwater. The level of Pb concentration has exceeded and several fold higher value in all groundwater than WHO drinking water standards and EQS. The Pb concentration range was 12 - 262 µg/L. Among 20 River water samples, 17 showed more than 50 µg/L Pb concentration. On the other hand, all groundwater samples showed Pb concentration ranging from 73 to a maximum of 155.9 µg/L. Elevated levels of Mn were also noticed in both types of water. The concentration range was 24.5 to 436 µg/L and 9.3 to 887.1 µg/L in river water and groundwater respectively. This study reveals the very high value of Pb in the water body, which should be a major concern for health and the environment. A follow-up investigation is suggested to find the source of this toxic pollutant (Pb) in the water body.

1.41 Distribution and Assessment of Trace Elements in the Sediment of Andharmanik River, Kuakata

S. Hossain; J.M. Piya; T. Hamid; K. M. Mamun; J. Kabir; S. Akter; Y. N. Jolly

The present study evaluated the distribution and content of the several trace elements (Fe, As, Mn, Cu, Zn, Cr, Ni, K, Ca, Ti, Co, Rb, Sr, Y, Zr, and Nb) in the 12 sediment samples of the Andharmanik river channel, Kuakata. Sediment samples were collected to assess the extent of contamination by these elements in the river. These elements were detected using ED-XRF. The mean concentration of the trace

elements in the sediments was organized in the descending order of Rb (2.5) > K (2.3) > Cr (2.3) > Zn (2.2) > Zr (1.3) > Y (1.1) mg/kg. Physicochemical parameters such as pH, and conductivity, were measured by multiparameter. Moreover, after applying sediment quality indices, the geo-accumulation index (I_{geo}) represents moderately polluted by Cr in St 06 and St 07. Contamination factor (CF) in St 06, and St 07 showed the value CF=6, placing them in the very high degree of contamination category. Analyzing the indices, the overall ecological risk of metal pollution from Andharmanik River sediment is moderate to good. However, in some locations, Cr contamination level was found in considerable level.

1.42 Distribution and Assessment of Trace Element Concentration in Sediments from Meghna Estuary

S. Hossain; A. R. Sumoni; T. Hamid; K. M. Mamun; J. Kabir; S. Akter; Y. N. Jolly

This Study focused on the pollution severity of the sediment of the Meghna River. Total metal content was determined using the ED-XRF technique. A total of 11 samples were collected at 2-3 km intervals. Besides physicochemical parameters and metal content, a comprehensive environmental assessment of risk was studied by applying the pollution load index (PLI), Degree of Contamination (DoC), Geo-accumulation index (I_{geo}), Contamination factor (CF), Ecological risk index (ERI), Enrichment Factor (EF), etc. The study investigated 16 commonly known trace elements- Arsenic (As), Iron (Fe), Manganese (Mn), Copper (Cu), Zinc (Zn), Chromium (Cr), Nickel (Ni), Potassium (K), Calcium (Ca), Titanium (Ti), Rubidium (Rb), Strontium (Sr), Yttrium (Y), Zirconium (Zr), Niobium (Nb), etc. The ranges for the analyzed trace elements are As (4.6-0.34); Fe (31387-17400); Mn (887.2-421.1); Cu (10.4-1.9); Zn (982.2-159.1); Cr (67.7-4.9); Ni (26.5-0.19); K (117880-212); Ca (54370-113); Ti (10070-4378.7); Co (4.4-0.03); Rb (237.9-99.5); Sr (193.2-143.1); Y (90.04-26.9); Zr (982.2-159.1); Nb (18.9-9.5) mg/kg. A significant aspect of this research is its contribution to environmental monitoring and risk assessment.

1.43 Heavy Metals Contamination Gradient Along Anthropogenic Activities on the Coastline Bangladesh

Y. N. Jolly, J. Kabir, S. Akter, S. Hossain, K. M. Mamun, Md. Tareque Bhuiyan

Determination of the heavy metal concentration in surface sediments and to evaluate the possible hazards to health on the people of the coastal region of Bangladesh will be conducted in this study. A total of 40 sediment samples have been collected from 8 sampling stations. Surface sediment samples, from upto 7 cm depth, were collected using a hand auger and well-blended by a metal shovel and then transferred into sampling bags. The sample bags were then carefully packed and shipped back to the laboratory for further processing.

1.44 Studies on Metal Transfer from Soil to Vegetables Cultivated Near Tannery Estates and Associated Human Health Risk Assessment

K. M. Mamun, Y. N. Jolly, J. Kabir, S. Akter, S. Hossain and Fazla Zawadul Arabi

The aim of the research was to investigate the heavy metal concentrations in vegetable and soil samples from the tannery estates of Hemayetpur, Savar, Dhaka using EDXRF (Energy Dispersive X-ray Fluorescence) techniques. 30 soil and 30 vegetable samples are collected from the agricultural lands and vegetable gardens near the tannery estates of Hemayetpur, Dhaka. Among them, 15 vegetable samples have already been prepared for analysis and the remaining 15 vegetable samples are currently being dried in AECD laboratory oven for the preparation of pellets. Similarly, soil samples will be prepared immediately after the vegetable samples. Trace and heavy metals K, Ca, Ti, Mn, Fe, Ni, Cu, Zn, Sr, Rb and Pb will be determined using the nuclear analytical technique, EDXRF to see the transfer of metals from soil to vegetables.

1.45 Indoor Particulate Matter Exposure and Correlation of PM_{2.5} with Lung Efficacy and SpO₂ Level of Dhaka City Dwellers

B. A. Begum, S. Nahian, S. Roy, T. R. Choudhury, & A. Salam

Indoor and outdoor PM concentrations were monitored in Dhaka using the IGERESS detector, revealing mean levels of PM_{1.0}, PM_{2.5}, and PM₁₀ at 91.7, 121, and 140 µg/m³, respectively. Nighttime indoor PM was 1.69 times higher than daytime levels, with indoor sources contributing 11% and 14% to PM levels during the day and night. During haze conditions, PM concentrations were 1.55 to 1.86 times greater than

non-haze periods, indicating worsened indoor air quality. The average peak flow rate and SpO₂ among 30 residents were 353 L/min and 98.7%, highlighting the need for measures to reduce indoor air pollution.

1.46 Heavy Metal Contamination of Surface Soils by Anthropogenic Activities: Concomitant Ecological and Health Risk Assessment

B. A. Begum, S. Akter, Y. N. Jolly, J. Kabir, K. M. Mamun, M. O. Rahman, M.A.M. Sarkar, M.M. Hasan, M.S. Rahman

Mean concentrations of Mg, K, Ca, Ti, Fe, Co, Cu, Zn, As, Rb, Sr, Zr, Pb, and Th in the sampling area were found to be 14,712, 11,828, 8,607, 4,378, 47,358, 10.93, 17.04, 151.57, 8.65, 191.08, 191.42, 263.64, 88.69, and 17.55 mg kg⁻¹, respectively. The geo-accumulation index and contamination factors indicated the sites were generally uncontaminated to moderately contaminated. Risk assessments showed negligible health hazards, with children being more susceptible to both carcinogenic and non-carcinogenic risks. Overall, geological and anthropogenic factors contributed to the elemental concentrations in the soil.

1.47 Seasonal Variation of PM_{2.5} and Black Carbon and Source Apportionment of PM_{2.5} by Using Backward Trajectory Approach

B.A. Begum, M. A. M. Sarkar, M. Hasan, K. Hasan, M. Mohinuzzaman, M. S. Rahman

PM_{2.5} concentrations are lower in warmer months and peak during the winter heating season, primarily due to energy consumption and atmospheric stability changes. The highest recorded PM_{2.5} concentration was 94.5 µg/m³, three times the monthly mean. Correlations indicated a negative relationship between PM_{2.5} and temperature (-0.17), rainfall (-0.51), and humidity (-0.021), while showing a positive correlation with wind direction (0.016). Trajectory analysis revealed significant PM_{2.5} contributions from Myanmar during the post-monsoon season and from the Bay of Bengal during the monsoon, with respective CWT values of 35-40 µg/m³ and 20 µg/m³.

1.48 Temporal Variations and Transport Pathways of Fine Particulate Matter and Black Carbon in Dhaka City, Bangladesh

B.A. Begum, M.A.M. Sarkar, M.M. Hasan, M.S. Rahman

This study collected fine particulate matter (PM_{2.5}) and black carbon (BC) from a semi-residential area on the Dhaka University campus from March 2018 to February 2019, measuring concentrations of PM_{2.5} (mean: 29.61 µg/m³) and BC (mean: 6.67 µg/m³). The BC/PM_{2.5} ratio averaged 0.256, varying from 0.01 to 0.70. Analysis revealed that both PM_{2.5} and BC peaked in winter and decreased during summer. Meteorological influences were assessed through statistical methods, with back trajectory clustering used to identify air mass transport pathways and potential source areas for PM_{2.5}.

1.49 Study on the Change of Air Pollution by Fine Particulate Matter with the Variance of Climate in Dhaka

B.A. Begum, M.A.M. Sarkar, M.M. Hasan, M.S. Rahman

This study uses back trajectory clustering and potential source contribution function (PSCF) to identify air mass transport pathways and emission sources contributing to pollution in the area. Concentration-weighted trajectory analysis with the HYSPLIT-4 model indicates significant long-range transport of PM_{2.5} from northwestern countries, alongside local emissions, especially during winter. The findings highlight the need for enhanced environmental monitoring and sustainable practices to reduce regional emissions. This research aims to support policymakers in developing effective air pollution mitigation strategies in South Asia.

1.50 Development of a Statistical Model for an Urban Road Traffic Noise Assessment in Dhaka City

B.A. Begum, M.A.M. Sarkar, M.M. Hasan, M.S. Rahman

Two approaches were used in the cross-validation method to assess the CORTN model's performance with 84 noise samples from two roads in Dhaka. The first approach involved nonlinear regression to recalibrate noise parameters using half the samples, while the second used 42 samples for calibration and the rest for testing. The model showed strong performance, with R² values of 0.99 and 0.85 and mean absolute errors of 2.50 and 5.39 dB(A) for each approach. Non-parametric tests confirmed satisfactory results for both calibration and performance testing.

1.51 A Study of Noise Pollution Measurements in a Semi-residential Area in Dhaka and its Possible Health Hazards.

B.A. Begum, M.A.M. Sarkar, M.M. Hasan, M.S. Rahman

Noise pollution in Dhaka, like other mega cities in developing countries, poses significant health risks, particularly for children, with reported effects including deafness and mental breakdown. Analysis revealed mean noise levels of 68.83 dB in the morning and 69.21 dB in the afternoon, with maximum levels reaching 80.81 dB and 96.75 dB, respectively. Noise often exceeds acceptable limits, and comparisons indicate a continuous increase in levels over time. The study stresses the urgent need for actions to mitigate noise pollution in the city.

1.52 Reduction of Household Air Pollution Through Clean Fuel Intervention and Recovery of Cellular Immune Balance

B.A. Begum, R. Raqib, E. Akhtar, M. A. Haq, S. Ahmed, F. Haque, M. Yunus.

Over 26 months, we provided LPG cook stoves and refills to 200 households and measured personal exposure to household air pollution (HAP) among 200 women. The intervention resulted in significant reductions in exposure: PM_{2.5} by 43.5%, black carbon (BC) by 13%, and carbon monoxide (CO) by 48%. Improvements in immune function were noted, with a decrease in BC correlating with increased Treg cells and memory B cells, while reduced CO was associated with higher early B cells and plasmablasts. Overall, the study demonstrates that exclusive LPG use positively impacts both HAP exposure and immune health.

1.53 Two Years' Exclusive Use of Liquefied Petroleum Gas (LPG) for Cooking Reduced Household Air Pollution Exposure Among Rural Bangladeshi Women

B. A. Begum, E. Akhtar, S. Ahmed, M. A. H. Chowdhury, S. B. Kader, M. H. Shahriar

Exposure to household air pollution (HAP) from biomass fuel combustion is a significant public health issue, affecting half the global population, particularly in low- and middle-income countries like Bangladesh. Over 75% of rural households in Bangladesh still rely on solid fuels, leading to indoor air pollution and increased health risks from pollutants like PM_{2.5}, CO, and BC. Previous randomized controlled trials on clean cooking fuel interventions often yielded inconclusive results due to low adherence. In an open-labeled trial involving 300 non-smoking women, 200 received LPG and education about clean fuel benefits, providing evidence to support policy updates on household air pollution.

1.54 Identification of Sources of Fine and Coarse Particulate Matter in Dhaka, Bangladesh

B.A. Begum, M.A.M. Sarkar, M.M. Hasan, M.S. Rahman

This study analyzes compositional data from coarse and fine particulate samples collected between December 2021 and February 2022 using Positive Matrix Factorization (PMF) to identify pollution sources. Conditional Probability Function (CPF) plots were created with local wind data to assess source directionality, while back trajectory methods helped trace potential source regions and transboundary transport pathways for PM_{2.5}. The Potential Source Contribution Function (PSCF) results, compared with CPF analyses, indicate likely source directions at varying distances. Findings reveal that coarse particles are primarily influenced by local sources.

1.55 Impact of Climate Variability on PM_{2.5} and Black Carbon Levels in Dhaka

B.A. Begum, M.A.M. Sarkar, M.M. Hasan, M.S. Rahman

This study examined variations in fine particulate matter (PM_{2.5}) and black carbon (BC) during the winter seasons of 2018 and 2022, finding mean PM_{2.5} concentrations of 47.95 µg/m³ in 2018 compared to 15.75 µg/m³ in 2022. The BC/PM_{2.5} ratio ranged from 0.07 to 0.27, indicating BC's significant contribution to PM_{2.5} pollution. Adverse meteorological conditions, such as lower temperatures and humidity, exacerbated pollution during winter. The study employed back trajectory clustering and the Potential Source Contribution Function (PSCF) to analyze air mass transport pathways and identify specific emission sources impacting pollution levels.

1.56 Investigating Climate-Induced Variations in PM_{2.5} and Black Carbon in Dhaka City

B.A. Begum, M.A.M. Sarkar, M.M. Hasan, M.S. Rahman

This study analyzed pollution sources using data collected between December 2022 and February 2023, applying Positive Matrix Factorization (PMF) to both coarse and fine particulate fractions. Conditional Probability Function (CPF) plots were created using local wind data to assess the directional impact of sources. Back trajectory methods identified potential source regions and transboundary transport pathways for PM_{2.5}. The results of the Potential Source Contribution Function (PSCF) were compared with CPF findings, indicating that improving air quality in Dhaka requires both local and regional control measures.

1.57 Seasonal Characteristics and Transport Pathways of Atmospheric Black Carbon over Dhaka City

B.A. Begum, M.A.M. Sarkar, M.M. Hasan, M.S. Rahman

Black carbon (BC) mass concentrations were measured in fine particulate samples using an EEL-type smoke stain reflectometer, revealing seasonal variations: winter ($12 \pm 6.37 \mu\text{g}/\text{m}^3$) was highest, followed by pre-monsoon ($7.78 \pm 3.96 \mu\text{g}/\text{m}^3$), post-monsoon ($7.2 \pm 2.98 \mu\text{g}/\text{m}^3$), and monsoon ($4.54 \pm 1.68 \mu\text{g}/\text{m}^3$). The annual mean concentration was $7.96 \pm 5.96 \mu\text{g}/\text{m}^3$. Conditional bivariate probability (CBPF) analysis indicated directional patterns, with the highest concentrations observed during winter. The Potential Source Contribution Function (PSCF) showed source regions with high CWT values, particularly from northern Bangladesh and surrounding areas, including parts of India, Nepal, and southern Tibet.

1.58 Status of Fine Particulate Matter in Dhaka City and Estimation of the Respiratory Deposition Doses

B.A. Begum, M.A.M. Sarkar, M.M. Hasan, M.S. Rahman

The average PM_{2.5} concentration was $70.41 \pm 59.08 \mu\text{g}/\text{m}^3$, significantly exceeding the WHO recommended limit of $10 \mu\text{g}/\text{m}^3$. Seasonal variations showed the highest levels in winter ($142 \pm 60.40 \mu\text{g}/\text{m}^3$), followed by post-monsoon, pre-monsoon, and monsoon. Temporal analysis revealed PM_{2.5} concentrations over four years: 69.32 ± 57.81 (2017), 73.55 ± 64.20 (2018), 71.85 ± 57.66 (2019), and 67.12 ± 56.01 (2020) $\mu\text{g}/\text{m}^3$. Long-range pollution sources were identified using the HYSPLIT-4 model and methods such as Concentration Weighted Trajectory (CWT), Potential Source Contribution Function (PSCF), and Simplified Quantitative Transport Bias Analysis (SQTBA), while potential health impacts were assessed using a multiple path particle dosimetry model.

1.59 Study on the Change of PM_{2.5} and BC with the Variance of Climate in Dhaka

B. A. Begum, M. A. M. Sarkar, M. M. Hasan, M. S. Rahman

Trajectory-based cluster analysis and concentration-weighted trajectory (CWT) methods were used to assess PM_{2.5} in Dhaka, revealing lower concentrations in warmer seasons and significant increases during winter due to biomass burning and air stability. The peak PM_{2.5} concentration reached $94.5 \mu\text{g}/\text{m}^3$, three times higher than the monthly mean. Correlation analysis indicated negative associations with temperature, rainfall, and humidity, while showing a positive correlation with wind direction. Key pollution sources identified include Myanmar and northeastern India during the post-monsoon, while Pakistan and northern states were major contributors during the pre-monsoon, and the Bay of Bengal was noted during the monsoon.

1.60 Atmospheric Particulate Matter and Associated Trace Elements Pollution in Bangladesh: A Comparative Study with Global Megacities

S. Kumar, N. Saha, A. A. Mohana, M. S. Hasan, M. S. Rahman, M. Elmes, G. R. MacFarlane

This study examines PM sources and transport mechanisms in Dhaka, highlighting consistently high particulate matter levels compared to other megacities, particularly in Africa and Asia. Notably, total suspended particulates (TSP) and PM₁₀ in Bangladesh show elevated concentrations of potentially toxic elements (PTEs), with lead (Pb) increasing over time. The findings emphasize the influence of temporal factors, geography, meteorology, and human activities on PM and PTE concentrations, providing valuable insights for policymakers to address air quality issues in Bangladesh.

1.61 Quantitative Assessment of PM_{2.5} Sources Over an Industrial Area in Dhaka City by Using PMF Coupled with Back Trajectory Clustering Methods

M. M. Hasan, M. A. M. Sarkar, M. S. Rahman and B. A. Begum

The annual average concentrations of PM_{2.5} and black carbon (BC) in Dhaka were $23.82 \pm 20.28 \mu\text{g}/\text{m}^3$ and $7.08 \pm 2.89 \mu\text{g}/\text{m}^3$, exceeding both Bangladesh's national air quality standards and WHO guidelines. Seasonal

analysis revealed the highest pollutant levels in winter and the lowest during monsoon, with correlations observed between meteorological factors and pollutant concentrations. Chemical analysis of 90 fine samples identified 17 trace metals, with sources determined through enrichment factor methods and positive matrix factorization (PMF) analysis.

1.62 Chemical Composition and Source Identification of PM₁₀, PM_{2.5} and Black Carbon in Residential and Industrial Area of Dhaka

B. A. Begum, M. A. M. Sarkar, M. Hasan, A. Hossain, J. Islam and M. S. Rahman

PM sampling used dichotomous samplers to collect PM_{2.5} and PM_{2.5-10} on Teflon filters, revealing higher concentrations of PM and BC in Darussalam compared to the Atomic Energy Centre. This discrepancy may be due to transboundary pollution from agricultural burning, despite greater local emissions in Darussalam. Principal Component Analysis and Positive Matrix Factorization were employed to identify pollution sources affecting air quality and health.

1.63 Real-Time Monitoring and Assessment of Fine Particulate Matter Pollution in Bangladesh

M. M. Hasan, M. A. M. Sarkar, M. S. Rahman and B. A. Begum

Air pollution in Bangladesh has surged, with average daily PM_{2.5} levels significantly exceeding WHO's recommended limit of 10 µg/m³. From February 2018 to December 2020, average PM_{2.5} concentrations during the dry season were highest in Dhaka (111.08 µg/m³) and lowest in Sylhet (67.98 µg/m³), while wet season levels dropped significantly across all cities. Overall, PM_{2.5} concentrations in major cities like Dhaka and Khulna were found to be 6-7 times higher than the WHO guideline.

1.64 Transboundary Dominated PM_{2.5} in Dhaka City - An Assessment of Temporal Variations and Long Range Transport Pathways

M. M. Hasan, M. A. M. Sarkar, M. S. Rahman and B. A. Begum

The average PM_{2.5} concentration in Dhaka was 70.41 ± 59.08 µg/m³, seven times higher than the WHO limit, with seasonal variations showing the highest levels in winter (142 ± 60.40 µg/m³) and the lowest in monsoon (29.08 ± 16.07 µg/m³). Temporal analysis revealed PM_{2.5} concentrations of 69.32 ± 57.81 (2017) to 67.12 ± 56.01 (2020) µg/m³, and long-range sources were identified using methods such as Concentration Weighted Trajectory (CWT) and Potential Source Contribution Function (PSCF).

1.65 Long Term Variations in Particulate Matter and Black Carbon Mass Concentrations in Dhaka City: An Assessment of Temporal Variation, Chemical Characterization and Contributing Sources

M. M. Hasan, M. A. M. Sarkar, M. S. Rahman and B. A. Begum

PM sampling using a GENT sampler revealed seasonal variations, with winter having the highest concentrations of PM_{2.5} (60 µg/m³) and BC (9.5 µg/m³). Analysis of 128 samples identified 17 trace metals, and Positive Matrix Factorization (PMF) indicated that over 49.5% of fine particle mass originates from anthropogenic sources, primarily brick kilns, road dust, and motor vehicles. The maximum concentrations recorded were 222.17 µg/m³ for PM and 9.12 µg/m³ for BC.

1.66 Chemical Characterization, Seasonal Variations and Source Apportionment of Trace Metals in Ambient Fine Particulate Matter in Dhaka City: A Comparative Study Between the Semi Residential and Industrial Area

M. M. Hasan, M. A. M. Sarkar, M. S. Rahman and B. A. Begum

The study used microbalance and EEL-type Smoke Stain Reflectometer to analyze aerosol masses and Black Carbon (BC) in PM_{2.5} samples, respectively. A total of 18 trace elements were identified using energy dispersive X-ray fluorescence spectrometry, and source apportionment revealed that the main pollution sources included brick kilns, soil dust, road dust, motor vehicles, fugitive lead, biomass burning, and sea salt. Multivariate techniques like principal component analysis (PCA) and positive matrix factorization (PMF 5.0) were employed for source identification.

1.67 Characterization, Source Identification and Hazard Index Assessment of Ingested Microplastics in Farmed Tilapia Oreochromis Niloticus

M. S. Rahman, M. A. M. Siddique, I. Hossain, M. M. Rahman

This study analyzed microplastic (MP) ingestion in the gastrointestinal tracts of farmed tilapia from Noakhali District, Bangladesh, finding a total of 199 MP particles, predominantly fibers (90.95%). The polymer hazard index indicated high risks for polypropylene (PP) and polyethylene terephthalate (PET), while polyethylene (PE) and polyvinyl chloride (PVC) were classified under "Danger" and "Extreme danger." The findings highlight the potential health risks associated with microplastic ingestion and suggest the need for further research.

1.68 Pollution Status and Ecological Risks of Metals in Surface Water of a Coastal Estuary and Health Risk Assessment for Recreational Users

M. S. Rahman, M. Varol, A. R. M. T. Islam

This study evaluated the levels and distribution of 16 metals in surface water from 18 sites in the Sundarbans estuary, revealing high concentrations of Sr, Al, B, and Fe. Notably, levels of Al, Fe, and Pb exceeded coastal water limits, with significant pollution identified across nearly all sites. Ecological risk assessments showed low to considerable risk at different locations, while the total hazard index for recreational children was above the acceptable level, indicating unsafe conditions for their health.

1.69 "Microplastic Seasoning": A study on Microplastic Contamination of Sea Salts in Bangladesh

M. S. Rahman, M. A. M. Siddique, A. Uddin, M. S. Hossain, S. M. A. Rahman, G. Kibria, G. Malafaia

This study examined microplastics (MPs) in 18 brands of commercial sea salt from Bangladesh, finding 100% contamination with a mean abundance of 471.67 MPs/kg. The most prevalent size class was 300–1500 µm, with black fibers and foams being the dominant shapes. Four main polymers were identified, and the mean polymer risk index ranged from 539 to 1257, highlighting the need for awareness and reduction of MP contamination in sea salts among consumers, industries, and policymakers.

1.70 Assessment of the Health Risks, Bioaccumulation, and Source Allocation of Trace Metals in Soil and Rice of Nearby Brick Kiln Industries in the Northern Part of Chattogram, Bangladesh

S. B. Quraishi, A. A. Maruf, D A Chowdhury, S Ganguli, M. N Alam, M. A. Maksud, S. R. Khan, L. N. Lutfu, T. R. Choudhury

Brick kilns in northern Chattogram are progressively congregating due to rising urbanization, industrial development, and construction purposes. This has been an alarming concern for the last few decades. This study aimed to estimate the level of heavy metals and their potential ecological and health risks in the soil and rice samples. We collected 40 soil and rice samples in the agricultural fields surrounding the nearby brick kilns. The soil and rice samples were digested and dissolved with HNO₃. An atomic absorption spectrometer (AAS) was used to ascertain and quantify the concentrations of the different heavy metals. No heavy metals from Pb, Cd, Cr, Hg, and As in the soil samples exceeded the maximum thresholds. In contrast, only arsenic in rice grain surpassed the maximum allowable limit. Geo-accumulation index (I_{geo}), contamination factor (CF), pollution load index (PLI), and ecological risk index (ERI) indicate that soil samples are less contaminated, indicating lower ecological risk. Furthermore, the mean bioaccumulation factor implies that very small amounts of heavy metals are accumulated in the rice grain samples. In contrast, rice grains with high HI values due to high THQ values of Pb may pose non-carcinogenic health risks. This study states that consuming rice in the study area over an extended period may pose a non-carcinogenic risk in the long run.

1.71 Comprehensive Analysis and Human Health Risk Assessment of Tap Water Quality, Dhaka City, Bangladesh: Integrating Source Identification, Index-Based Evaluation, and Heavy Metal Assessment

S. B. Quraishi, T. N. Ariyan, A. Kabir, M. N. E. Alam, M. A. Maksud, S. R. Khan, L. N. Lutfu, S. Sultana, T. R. Choudhury

The majority of drinking water source for most of the megacities around the world are tap water provided through supply pipeline system by the respective part of the government. Even though these supplied water gets contaminated in various ways, the city dwellers are bound to rely on that. Dhaka being one of the most densely populated metropolitan megacities of the world, situated in a developing country, is no different. In this study, the ultimate goal was to assess the tap water quality of Dhaka city, Bangladesh. In this study,

cumulatively, 35 samples were collected from separate locations of Dhaka city. Heavy metal (Fe, Mn, Cd, Co, Cr, Ni, Cu, As, Hg, Zn, and Pb) concentrations were determined using Atomic Absorption Spectrometer (AAS) and physico-chemical parameters were measured using Multi-parameter (pH, DO, EC, TDS, Salinity), Thermometer, (Temperature), Turbidity meter (Turbidity) and Titrimetric method (Cl^- , Total hardness, Total alkalinity, Ca and Mg) and UV-spectrophotometer (SiO_2 and SO_4^{2-}). In this study, it was found that amongst the assessed heavy metals, Hg (1.18 ± 0.007 ppb) concentration was found at an alarming amount. Mn and Fe were also a matter of concern. The analyzed indices alluded that tap water of Dhaka city was in the range of very poor (HPI: 95.66, WQI: 84.69), moderately affected or polluted (MI: 2.61, SPI: 0.96) to slight pollution (Pij: 2.61 and NPI: 1.41) and healthy but not tasty (THI: 10.77, 1.8). Throughout the sampling sites, Matuail, followed by Jurain, were found to be the most hazardous ones.

1.72 The Ecological Impact of Microplastics and Heavy Metal Pollution on Juvenile Aquatic Life in the Sundarbans Bangladesh

S. B. Quraishi, Irine, M. N. E. Alam, M. A. Maksud, S. R. Khan, L. N. Lutfu, S. Sultana, T. R. Choudhury

This study was taken to assess the ecological impact of Microplastics and heavy metal pollution on juvenile aquatic life in the Sundarbans Bangladesh. A total of 10 aquatic marine fish and almost 60 sediment sample were collected to study the probable impact of microplastic and heavy metals on that samples. The fish samples were digested using microwave digestive system and analyzed toxic metals (Pb, Cd, Cr) using graphite furnace atomic absorption spectrometry. The sediment samples are now under digestion process.

1.73 Metallic Symphony: A Comprehensive Quantitative Analysis of Heavy Metal Concentrations in Coastal Waters Adjacent to a Coal Fired Power Plant in Bangladesh

T. R. Choudhury, M. Farukuzzaman, M. Nur E Alam, M. A. Maksud, S. R. Khan, L. N. Lutfu, S. Sultana, M. J. Sarker

This study was carried out to measure the concentration of heavy metals in sediments and fish from a river adjacent to a coal-fired power plant, so as to assess their allied ecological and human health risks. Atomic absorption spectrophotometer (AAS) was employed in this study for measuring heavy metal concentration (mg/kg). The average concentration (mg/kg) of six selected metals in fish and shellfish followed the trends of $\text{Cu} (8.07) > \text{As} (1.86) > \text{Cr} (1.79) > \text{Ni} (0.68) > \text{Pb} (0.27) > \text{Cd} (0.21)$ and all those heavy metals were lower than the permissible limits stated by national (e.g., MOFL) and international (e.g., FAO, WHO, EC, NOAA) agencies (except As). The metal pollution index (MPI) indicating metal consumption rate was high in *Macrobrachium rosenbergii* and *Lates calcarifer* than other fishes. However, the estimated daily intake (EDI) values in the study area for adult and children were lower than the recommended daily allowance (RDA). In addition, the Targeted Hazard Quotient (THQ) and Hazard Index (HI) values for adult and children consumers were < 1 , indicating that consumers would not experience the non-carcinogenic health effects. Although children were more susceptible than adults, carcinogenic risk (CR) exposure of all metals for all the consumers was found in the acceptable range (10^{-6} to 10^{-4}) whereas, Pb and Cr were negligible for all the consumers.

1.78 Differential Patterns of Heavy Metal Contamination and Nutrient Levels: A Comparative Study among Sandwip Island, Patenga on the Southeastern Coast, and the Karnaphuli River

T. R. Choudhury, M. A. Alam, M. N. E. Alam, M. A. Maksud, S. R. Khan, L. N. Lutfu, S. Sultana, A.M. S. Chowdhury

This study presents a comprehensive investigation into variations in heavy metal contamination and nutrient levels within the Lower Meghna estuary (Sandwip), the southeastern coast (Patenga Sea beach area), and the Karnaphuli River in Bangladesh. A thorough analysis of 24 heavy metals and anions was conducted across multiple sampling points to discern spatial and temporal trends. The results revealed distinctive patterns in heavy metal concentrations, with Sb, Ba, and Se exhibiting variations across sites, and Cd, Cu, and Zn indicating potential anthropogenic influences. Notably, Patenga exhibited significantly higher contamination levels of Ca, K, B, and Ni compared to Karnaphuli and Sandwip, where Cu and Pb were almost absent. Se and As were predominantly found in the Sandwip region, with the other two areas showing minimal presence. Nutrient analysis uncovered diverse ion concentrations, indicative of dynamic ecological processes. These findings provide essential insights into the environmental health of the studied water bodies. The observed

spatial and temporal trends in heavy metal contamination and nutrient levels offer valuable information for policymakers and environmental scientists. This knowledge can inform the development of strategic interventions aimed at mitigating contamination and preserving the ecological balance of these vital ecosystems. The study recommends further research to monitor long-term trends and assess potential impacts on aquatic life and human health, thereby contributing to the sustainable management of these critical water resources.

1.79 A Coupled Pollution Assessment, Pollution Region Detection, and Source Identification of Soil Heavy Metal(oid)s Contamination in Different Land-Use Patterns

T. R. Choudhury, A. A. Yeamin, M. N. E. Alam, M. A. Maksud, S. R. Khan, L. N. Lutfu, S. Sultana, A. R. M. T. Islam

Understanding of soil quality evaluation, pollution region detection and source identification is crucial for implementing soil pollution prevention and safety use strategies from the global perspective of soil heavy metal(loid)s contamination. This study aims to provide a comprehensive approach to understanding and managing soil contamination for better environmental health and land-use planning. In this study, soil static environmental carrying capacity (Pi) model for eight heavy metal(loid)s was chosen to assess pollution risks in different land-use soils of Chilmari port area, northern Bangladesh. Coupled with geostatistical model and self-organizing map (SOM), the pollution area and spatial pattern were detected along with uncertainty analysis. Potential source was quantitatively apportioned using a positive matrix factorization (PMF) model. The average concentrations of Cr (~3.5 times), Pb (~3 times) and As (~1 time) were higher than their background values in soils regardless of different land-use patterns in the study area. Results showed that agricultural and commercial soils were primarily contaminated by Cr, Pb and As based on the Nemerow pollution index (NPI), ecological risk (ER) and Pi indices. The Pi assessment found more than 70% of areas were identified as polluted soils for Pi-Pb and Pi-Cr with little uncertain areas while Co was detected as a high portion of uncertain pollution area. Based on one-way ANOVA test, Pb, Cu, and Zn concentrations were related to the human-induced source, indicating statistically significant differences in their contents among different land-use soils.

1.80 Assessment of Water Quality Parameters in Five Major River in Dhaka Region of Bangladesh

T. R. Choudhury, Md. NurEAlam, M. A. Maksud, S. R. Khan, L. N. Lutfu, S. Sultana

The stress on our water environment as a result of increasing industrialization, which aids urbanization, is becoming very high thus reducing the availability of clean water. Polluted water is of great concern to the aquatic organisms, plants, humans, and climate and indeed alters the ecosystem. So the toxic metal burden in five river water in Bangladesh has assessed here. The major five river Buriganga, Shitalakshya, Balu, Turag and Bangshi are such rivers those are extremely polluted through various human activities along their courses. The study was conducted to assess the physical and chemical water quality parameters of those. The water samples were collected 15(Fifteen) different geographic locations along each river in 2022 during both dry and wet season. And Total 83 numbers of samples were collected of each season. A number of physiochemical water quality parameters including Dissolved oxygen (DO) concentrations, Alkalinity, Turbidity, pH, Total dissolved sediment (TDS), Biological oxygen demand (BOD), Conductivity(EC), Colour readings and Water temperature. The mean value of such respective parameters in both season were compared with the water quality standards as set by the EQS guideline, ADB, and the guideline of Department of Environment (DoE) in Bangladesh. Different toxic metals As, Hg, Pb, Cd, Cr, Co, Ni, Cu, Zn, Mn, Fe, Na, K, Ca, and Mg was ascertained using atomic absorption spectrophotometry.

1.81 Heavy Metal Pollution in Salt From Different Locations in Cox's Bazar District

T. R. Choudhury, W. Islam, M. N. E. Alam, M. A. Maksud, S. R. Khan, L. N. Lutfu, S. Sultana, S. Saha, M. A. I. Palash, P. Kundu, A. Hasan, S. M. M. Uddin, M. M. Rahman, A. Sarker, M. A. Baki

Edible salt is the most used food additive worldwide. Therefore, any contamination of table salt could be considered a health hazard to consumers. The present study aims to determine the levels of heavy metals in unrefined edible salts. In this study, a total of thirty-two samples were collected from 32 locations across sixteen stations that have been selected as these are frequent salt production areas in Cox's Bazar. As a preliminary finding, the presence of 15 heavy metals such as Sb, Se, Sn, Mn, Sr, Ba, Co, Al, Cd, Pb, Cr, Cu, Ni, As, and Zn have been detected. Salt samples (n = 32) were prepared for the detection of heavy metal

through atomic absorption spectroscopy and ICPMS & mean concentrations $\pm$ S.D. (mg/kg) were compared with Quality Standards. The range of these metals is As(0.0015-7.08), Ba(0.79-35.7), Cd(0.001-1.45), Co(0.06-0.22), Cr(0.08-1.37), Cu(0.82-9.55), Ni(0.274-78), Pb(0.125-6.85), Sb(0.005-5.94), Se(0.005-118.45), Al(12.51-1310), Mn(1.18-721.5), Sn(0.005-32.95), Sr(29.02-1038) and Zn(7.72-463.1) mg/kg respectively. The work is in progress

1.82 Assessment of Isotopic Signature ($\delta^{13}\text{C}$ & $\delta^{15}\text{N}$) in the Most Undisturbed Sediment Cores at Sundarbans Mangrove Area of Bangladesh in Studies of Sea Level Rise as well as Heavy Metal Association with the Isotopic Ratio ($\delta^{13}\text{C}/\delta^{15}\text{N}$)

M. N. E. Alam, AKMA Ullah, M. M. Hosen, M. A. Maksud, S. R. Khan, L. N. Lutfu, S. Sultana, T. R. Choudhury, S. B. Quraishi

To examine the applicability of C/N, organic carbon stable isotope ($\delta^{13}\text{C}$), organic nitrogen stable isotope ($\delta^{15}\text{N}$) and association with heavy metals in studies the sea level of the Bay of Bangle in the Sundarbans mangrove area in Bangladesh. We observed the distribution of carbon, nitrogen, $\delta^{15}\text{N}$ and $\delta^{13}\text{C}$ in undisturbed sediment cores collected from the present subaqueous delta. Mangrove sediment cores (0-35 cm) from the studied area were collected by core sampler for the examination of $\delta^{13}\text{C}$ and $\delta^{15}\text{N}$ and organic carbon and nitrogen contents with the association of nine heavy metal (Pb, Cd, Cr, As, Fe, Mn, Co, Ni, and Zn). The $\delta^{13}\text{C}$ of surface (0-2 cm) sediments from the whole mangrove area gave approximately the same value (26‰) except only one station at the far from coastal area, with an enriched value of 20‰. The $\delta^{15}\text{N}$ value of sediments at this station was quite low compared to the other stations nearby. The $\delta^{15}\text{N}$ values of sediments in the near the coastal area were somewhat lower than those in the far coastal area. High organic carbon content of sediments occurred in the far coastal region. Organic nitrogen contents in the sediment showed almost the same pattern as that of organic carbon contents. The atomic ratios of carbon to nitrogen were high at the most near the coastal area and low in the far from coastal area. Again, along with the core depth, the $\delta^{13}\text{C}$ and $\delta^{15}\text{N}$ and its ratio distributed with in irregular pattern. That was indicated the unavailability to measure the sedimentation rate in that area. But a significant association was found for the heavy metal level with the isotopic ratio. With the increasing the core depth the association varied with positive to negative for most of the metals. Overall, our results can support the idea that the sediments in the mangrove area were mostly derived from the primary production in that region. Particularly, bottom environments in the near coastal area receive large inputs of green algae but the far from coastal area receive large input of humid source.

1.83 Heavy Metal Ratio Assessment and Hazard Evaluation in Soil, Water and Plants of the Chilai Canal Area, Gazipur: A Comparative Study

T. R. Choudhury, S. Tabassum, H. S. Chayan, M. N. Alam, M. A. Maksud, S. R. Khan, L. N. Lutfu, S. Sultana, M. Parveen

In this study the hazard factors for human populations were evaluated by examining the transfer of metals from urban effluents to plants via contaminated water and soil, ultimately assessing the health risks associated with consuming metal-accumulated leafy vegetables. The concentrations of metals (Pb, Cd, Cr, Cu, Ni, and As) in leafy vegetables grown under varying exposure conditions via and including control and urban effluent-contaminated canal waters and soils, were determined using an Atomic Absorption Spectrophotometer (AAS). Specifically, Red Spinach (*Amaranthus dubius*) was studied under various scenarios, while Malabar Spinach (*Basella alba*) was examined under waterlogged conditions. These vegetables were cultivated using water and soil samples collected from the banks of the Chilai Canal in Gazipur, Bangladesh. According to the study, the levels of metals in the polluted soil were higher than the WHO-recommended tolerable limits. Contaminated water and soil were shown to be more polluted than the water and soil from the control. Leafy vegetables grown on polluted soil had metal concentrations that were higher than those of agricultural soil and over the allowable limit. In this case, both soil and water is unusable for sector 1 and 2, and for sector 3, contaminated water and soil increase risk when used together. For waterlogging, Sector 2 and 3 is significantly polluted. Additionally, the findings showed that compared to agricultural soil that was not contaminated, the plants in contaminated soil had a higher incidence of metal translocation. On the case of vegetables grown on contaminated soil and water, the values of each risk indicator were more than 1. Thus, the potential risk of developing cancer and other chronic illnesses surfaced if those contaminated veggies were consumed on a regular basis.

1.84 Evaluation of Heavy Metals in Water, Soil, Sediment and Anions in Water Collected from Chittagong Industrial Area and their Possible Health Risk Assessment

T. R. Choudhury, S. Riad, M. N. Alam, M. A. Maksud, S. R. Khan, L. N. Lutfu, S. Sultana A.M. S. Chowdhury

The objective of this study is to analyze the concentrations of heavy metals and anions in various environmental matrices from the Chittagong industrial area for understanding the extent of pollution and its implications for human health risk in the region. 14 sampling sites have been selected for water, anion and sediment (0-5 cm) and 11 sampling sites for soil (0-5 cm) have been selected. The samples have been collected on March 2023 and analyzed by using ICP-MS and Ion Chromatography. According to the result, the values followed the ascending order: For water: $Ba < Sn < Sb < Fe < Ti < Mo < Pb < As < Sr < B < Ca < Mg < Cr < Cd < Ag < Se < Co < P < Li < K < Zn < Ni < Hg < Mn$. The contamination factor (CF) followed the descending order: for sediment: $Ag > Cd > Hg > As > Cr > Pb > Ni > Cu > Zn > Co > Fe$. The anions are in high concentration in water. Mean concentrations of these anions followed the descending order: $Cl^- > SO_4^{2-} > Br^- > F^-$. The soil is comparatively pure as the trace metals have not exceeded the critical limit according to the study.

1.85 Evaluation of Heavy Metals in Water, Sediment and Anions in Water Collected from Patenga Sea Beach Area and Sandwip Island and their Possible Health Risk Assessment

T. R. Choudhury, S. Riad, M. N. E. Alam, M. A. Maksud, S. R. Khan, L. N. Lutfu, S. Sultana A.M. S. Chowdhury

Due to unplanned industrial activities and the impacts of climate change, heavy metals and anions have been detected at potentially dangerous concentrations in numerous water sources. This study aims to analyze the presence and concentration of these contaminants in water and sediment samples from the Patenga Sea Beach area and Sandwip Island. By assessing the potential health risks associated with exposure, the research seeks to provide essential insights into the environmental quality and public health implications for residents and visitors of these areas. 20 sampling sites have been selected for water, anion and sediment (0-5 cm). The samples have been collected on March 2023 and analyzed by using ICP-MS and Ion Chromatography. According to the metal pollution index for Patenga, the most founded metal followed the ascending order: For water: $V < Li < Pb < Cd$ and for Sandwip $Cd < V < Li$. The contamination factor (CF) followed the descending order: for sediment: $Se > Sn > Ni > Pb$ (Sandwip); $Se > Ni > Sn$ (Patenga). The anions are in high concentration in water. According to the mean concentrations (mg/L) of these anions followed the descending orders: $Cl^- > SO_4^{2-} > Br^- > F^-$.

1.86 Analyzing the Environmental Threshold Level of Toxic Metals for Consumable Seaweed in Bangladesh

T. R. Choudhury, K. B. Hafiz, M. N. E. Alam, M. A. Maksud, S. R. Khan, L. N. Lutfu, S. Sultana, S.M. M. Rahman

The study systematically studied the bioconcentration and accumulation tendencies of two seaweed species, *Ulva* and *Gracilaria*, towards toxic metals Chromium (Cr), Cadmium (Cd), and lead (Pb). The study used different imposed concentrations of these metals and followed the seaweeds' responses over a 7-day period. Notably, both seaweeds demonstrated a strong ability to accumulate metals, with *Ulva*'s Bioconcentration Factor (BCF) reaching as high as 105.2 in the context of Chromium. *Ulva*, in particular, frequently exceeded the acceptable reference threshold for Chromium of 0.0003 mg/kg BW/day even at zero imposed concentration, indicating its potential as a bioindicator for Chromium-polluted waterways. *Ulva*'s deposition of Cadmium above the standard threshold of 0.001 mg/kg BW/day when the imposed concentration approached 10 ppm with BCF values exceeding 100. While both seaweeds accumulated lead below the standard threshold of 0.003 mg/kg BW/day, *Ulva* had BCF values exceeding 90 at higher imposed concentrations. The study emphasizes these seaweeds' dual role as bioaccumulators for bioremediation, as well as the associated issues for direct human eating without sufficient processing due to high metal concentrations. These findings pave the way for regulatory agencies to develop educated guidelines to ensure the safety of seaweed products while also emphasizing the significance of monitoring metal concentrations in areas where seaweed is used as a dietary staple. The key findings highlighted both seaweeds' susceptibility to absorb metals, particularly Chromium. Even at a baseline concentration of 0 PPM, *Ulva* demonstrated

Chromium levels as high as 313.71, much exceeding the human consumption reference threshold of 0.0003 mg/kg BW/day.

1.89 Indoor Particulate Matter Exposure and Correlation of PM_{2.5} with Lung Efficacy and SpO₂ Level of Dhaka City Dwellers

T. R. Choudhury, S. Nahian, A. Salam, and B. A. Begum

This study investigated indoor exposure of particulate matter (PM) at six residential homes in Dhaka, Bangladesh, to assess the degradation of indoor air quality (IAQ) by PM_{1.0}, PM_{2.5} and PM₁₀, as well as correlate indoor PM_{2.5} with occupants' lung efficacy and blood oxygen saturation (SpO₂). Concentrations of indoor and outdoor PM were monitored individually at day and night using IGERESS Air Quality Monitoring Detector. Mean concentration of indoor PM_{1.0}, PM_{2.5} and PM₁₀ were 91.7 ± 47.2 , 121 ± 62.4 , and 140 ± 72.0 μgm^{-3} , respectively. Indoor PM of all size ranges at night were found to be 1.69 times higher than their corresponding daytime concentration. Mean I/O ratio (I/O_{day} = 0.95 and I/O_{night} = 0.93) and strong positive correlation ($R^2_{\text{day}} = 0.90$ and $R^2_{\text{night}} = 0.80$) between indoor and outdoor PM confirmed infiltration of polluted outdoor air inside the households. Indoor sources had 11% and 14% contribution to indoor PM during day and night, respectively. For Cantonment site, PM measurement was conducted during haze and non-haze weather. Haze-time PM concentration was 1.55 to 1.86 times greater than the non-haze period, which indicated that despite the same indoor environment, infiltrated outdoor PM during haze deteriorated IAQ. The average peak flow rate and SpO₂ of 30 inhabitants in six sampling households were 353 L min⁻¹ and 98.7%, respectively. Peak flow rate showed strong, negative correlation ($R^2 = 0.82$) with indoor PM_{2.5} concentration, which implied that inhalation of excess PM_{2.5} was probably responsible for the reduced lung function of the residents. However, no association could be established between SpO₂ and indoor PM_{2.5} concentration. These outcomes indicated severely compromised IAQ in urban Dhaka households, so necessary measures are required to reduce the extent of indoor air pollution.

1.90 Water Quality and the Presence of Metals in Crustaceans (*Sartoriana spinigera*) and Mollusks (*Pila globosa*) Close to an Urban Waste Landfill in Kodda at Gazipur

T. R. Choudhury, M. N. Mondal, D. M. R. H. Siddiqui, M. N. E. Alam, M. A. Maksud, S. R. Khan, L. N. Lutfu, S. Sultana

Degradation of water and sediment quality along with other aquatic ecosystem components, due to urban waste is a significant concern that demands attention. Despite of the multifaceted use of the Konabari area within the Gazipur City Corporation of Bangladesh, limited studies have assessed the health of the floodplain ecosystem adjacent to urban waste landfills in Kodda. This research focuses on evaluating water quality parameters and the presence of metals and metalloids in water, sediment, and biota (invertebrates) in the lowland floodplain near the Kodda municipal landfill in Gazipur district. In December 2022, thirteen composite samples, including water, sediment, crustaceans (*Sartoriana spinigera*), and mollusks (*Pila globosa*), were collected from the designated sampling site. Surface and sub-surface (0–15 cm depth) water were collected using a water sampler for water quality analysis, and the presence of heavy metal and metalloid content of the water, sediment, crabs, and mollusks were analyzed using an atomic absorption spectrometer. The results indicated dissolved oxygen concentrations ranging from 0.30 to 5.81 mg/l (mean 3.1 ± 2.37 mg/l). Certain locations directly affected by waste discharge exhibited alarmingly low dissolved oxygen levels (~ 0.71 mg/l), coupled with elevated temperatures and phosphate (PO₄³⁻) content (2–7.4 mg/l).

1.91 Assessing Trace Metal-Based Human Health Risks for Commonly Used Body Soaps in Bangladesh

M. N. E. Alam, T. R. Choudhury, K. B. Hafiz, , M. A. Maksud, S. R. Khan, L. N. Lutfu, S. Sultana, S. Ganguli

In Bangladesh, body soaps are very popular among consumers due to their flavors and low alkali content. The current study assesses the contamination of several trace metals (TMs) such as iron (Fe), copper (Cu), zinc (Zn), chromium (Cr), manganese (Mn), nickel (Ni), cadmium (Cd), and lead (Pb) in some of the body soaps most commonly used in Bangladesh. The concentrations of Fe, Cu, Zn, Cr, and Mn were found within the acceptable limits stipulated by the World Health Organization (WHO); however, in contrast, the concentrations of Ni, Cd, and Pb remained below the detection limit. Notably, the concentration of Cr in two soap samples (S-2, S-3) out of twenty-one soap samples exceeded the permissible limit stipulated by the

WHO. Health risks associated with the TM intake via dermal routes were evaluated in terms of chronic daily intake (CDI) and hazard quotient (HQ). The results indicated that no non-carcinogenic risks (NCR) are likely to occur owing to the use of those body soaps. The carcinogenic risk (CR) estimated for Cr revealed no possibility of probable carcinogenic diseases. Though the NCR and CR are unlikely to occur resulting from the long-term uses of these soaps, the present study provides baseline information on the possible contaminations of TMs in the beauty soaps that do not seem to have been reported so far in Bangladesh. In light of the above information, it can be concluded that the presence of TMs in the body soaps could be a warning for people in general thereby suggesting continuous monitoring.

1.92 Evaluation of Heavy Metal in Waste Water of Textile Industries Collected from Effluent Treatment Plant

Y. N. Jolly, J. Kabir, S. Akter, Konica. J. Fatema, K.M. Mamun.

Textile Industries in Bangladesh is one of the leading sectors. This sector meets up our domestic needs and also exporting to over the United States and Europe. Textile industry is the most water consuming industry. Huge amount of waste water from these industries can become a considerable source of environmental contamination. Hence, it is mandatory to limit hazardous wastewater discharging from the textile or garment industry by setting up effluent treatment plant (ETP). This work was conducted to assess the extent of heavy metal contamination in wastewater of effluent treatment plant (ETP) and to evaluate the ecological risk.

1.93 Interaction of Carcinogenic Polycyclic Aromatic Hydrocarbon with Soil Macromolecules: Extrapolation of GC-MS Findings with Molecular Dynamics Approach

Md Shohel Rana PhD

Versatile Polycyclic Aromatic Hydrocarbons (PAHs) molecules have a great potential to induce cancer disease and could be bioaccumulated through ecosystem. Soil samples collected from RNPP surrounding areas (Rooppur Nuclear Power Plant, Rooppur at Padma River Site and Hardinge Bridge) were investigated for a few PAHs molecules like Naphthalene, Phenanthrene, Anthracene and Fluorene using GC-MS technique and later correlation of interaction of PAHs molecules with soil macromolecules, humic acid and fulvic acid was established by molecular dynamics (MD) simulation. In the specimens of Rooppur at Padma River site and Hardinge Bridge site, the concentrations of the subjected PAHs were observed higher in the deeper soil samples (Naphthalene: 130.22 ppb and 107.10 ppb; Phenanthrene: 108.807 ppb and 98.341 ppb; Anthracene: 105.73 ppb and 95.56 ppb; Fluorene: 26.87 ppb and 25.46 ppb respectively) than that of the surface (Naphthalene: 51.75 ppb and 0.810 ppb; Phenanthrene: 49.60 ppb and 89.674 ppb; Anthracene: 48.2 ppb and 87.14 ppb; Fluorene: 14.50 ppb and 17.29 ppb respectively). On contrary, the concentrations of the PAHs were found in opposite fashion at Rooppur Nuclear Power Plant boring site: deeper soil (Naphthalene: 2.06 ppb; Phenanthrene: < MDL; Anthracene: < MDL; Fluorene: < MDL) and the surface soil (Naphthalene: 40.56 ppb; Phenanthrene: 13.89 ppb; Anthracene: 13.51 ppb; Fluorene: 4.001 ppb). Later, Molecular dynamics (MD) simulation study revealed the greater pi-pi interaction for Naphthalene, Phenanthrene and Anthracene molecules whereas pi-Alkyl and H-bonds interactions were further counted for Fluorene molecule with the mentioned humus substances.

1.94 Atmospheric Brown Carbon (BrC): Analysis of 4-nitrophenol (4NP) in Air of Dhaka city

R. Sultana, M. A. Hossen, M. F. Ehasan, A. K. M. A. Ullah, M. A. Salam and A. R. M. Tareq

4-Nitrophenol is an atmospheric pollutant that detected in environmental air considered hazardous for environment because of its stability as it is resistant for biological and chemical oxidation. As an organic aerosol it has harmful impact on air quality, visibility and also on human health. Several anthropogenic activities such as combustion of biomass, vehicle fuel, aviation fuel and incineration of waste is the ingress pathway of 4-Nitrophenol in environmental air. This investigation is to examine the presence of 4-Nitrophenol and to quantify in environmental aerosols. Fourteen samples were collected using quartz filter (PM_{2.5}) paper for the assessment of BrC (nitrophenols) in air from two distinct locations of Dhaka city. The sampling stations are Dhaka University station (Dhaka south) and Mirpur-1 (Dhaka north) area. Newly developed method was applied for analysis the extracted samples. The recovery rates of different phenol and phenolic derivatives were varied from 65% to 120% and the values of regression coefficient about 0.997 indicates the reliability and validity of the method of analysis. Then splitting up the quartz filter into smallest possible size required mixture of Ethyl acetate and Dichloromethane (1:1) was added. r. The filtered mixture

was pre-concentrated by Rotary Evaporator. GC-FID was applied for the analysis of extracted samples. The average concentration of 4-nitrophenol in monsoon, post monsoon and winter season in Dhaka University area are $2.32 \mu\text{g}/\text{m}^3$, $2.50 \mu\text{g}/\text{m}^3$ and $4.535 \mu\text{g}/\text{m}^3$ respectively and in Mirpur area are $1.37 \mu\text{g}/\text{m}^3$, $1.65 \mu\text{g}/\text{m}^3$ and $1.62 \mu\text{g}/\text{m}^3$ respectively. From the study we can see that in winter air aerosol contains maximum amount of 4-nitrophenol and minimum in monsoon due to rain effect.

1.95 Study of Atmospheric Organic Pollutants of Fine Particulate Matter in Dhaka City, Bangladesh

A. R. M. Tareq, M. F. Ehasan, M. A. Hossen, R. Sultana, A. K. M. A. Ullah, M. A. Salam

Brown carbon, the light-absorbing part of atmospheric organic aerosols has a great impact on radiation balance of earth by absorbing and scattering solar radiation and considered as an important component of climate forcing. Our research interest in this Brown carbon was originally stimulated to study the localized air pollution by Phenols and Phenolic derivatives and to compare their levels in the two parts of Dhaka city, that is Dhaka north and Dhaka south. Samples were collected from different location of Dhaka city using air sampler with quartz filter paper. Dichloromethane and ethyl acetate (1:1v/v) were used for the extraction of phenols and some phenolic derivatives in air samples. GC-FID technique were applied for the analysis of phenol, 2-methyl phenol, 3-methyl phenol, 2-methoxy phenol, 2, 4-dimethyl phenol, catechol and 4-nitrophenol in collected air samples. Newly developed method was applied for analysis the extracted samples. The recovery rates of different phenol and phenolic derivatives were varied from 65% to 120% and the values of regression coefficient about 0.997 indicates the reliability and validity of the method of analysis. The average concentration value for phenols and phenolic derivatives in monsoon, post monsoon and winter season in Dhaka south area are $0.20 \mu\text{g}/\text{m}^3$, $0.16 \mu\text{g}/\text{m}^3$ and $0.49 \mu\text{g}/\text{m}^3$ respectively and in Dhaka north area are $0.06 \mu\text{g}/\text{m}^3$, $0.14 \mu\text{g}/\text{m}^3$ and $0.11 \mu\text{g}/\text{m}^3$ respectively. Whereas the guideline values for phenols and phenolic derivatives expected be low, at about $0.001 \mu\text{g}/\text{m}^3$. The concentrations of Phenols and Phenolic derivatives in Dhaka north are lower than the concentrations in Dhaka south.

1.96 Polycyclic Aromatic Hydrocarbons (PAHs): An Approach of Air Organic Pollution of Dhaka City, Bangladesh

M. F. Ehasan, R. Sultana, A. K. M. A. Ullah and A. R. M. Tareq,

PAHs are widespread environmental pollutants, having mutagenic nature and potential carcinogenicity are formed during incomplete combustion of organic materials and carbonization. Polycyclic aromatic hydrocarbons (PAHs) in $\text{PM}_{2.5}$ pose potentially serious threats to human health. Our study is to examine the levels of aerosolic polycyclic aromatic hydrocarbons (PAHs) in Dhaka city in the light of such influence of PAHs for human health. Total fourteen (14) $\text{PM}_{2.5}$ samples were collected from two distinct locations of Dhaka city, one is in Dhaka University area, Dhaka South and another one is in Mirpur area, Dhaka north. Quartz filter were used for sampling, splitting up the quartz filter into smallest possible size 30 mL mixture of ethyl acetate and dichloromethane (1:1v/v) was added as extracting solvent. Microsonication and orbital shaking were used for the separation of organic moiety. The extracted solution was evaporated using N_2 for preconcentration to a certain volume for analysis and then analyzed using gas chromatography (GC) with flame ionization detector (FID) where VF5ms column was used for chromatographic separation. Naphthalene, Acenaphthene, Fluorene, Phenanthrene, Anthracene, Pyrene, Benzo(a)anthracene and Chrysene were analyzed for assessment. The study reveals that the concentration of PAH_8 in $\text{PM}_{2.5}$ of Dhaka University area is greater than the concentration of Mirpur area. The average value for PAHs in monsoon, post monsoon and winter season in Dhaka University area are $0.21 \mu\text{g}/\text{m}^3$, $0.35 \mu\text{g}/\text{m}^3$ and $0.50 \mu\text{g}/\text{m}^3$ respectively and in Mirpur area are $0.30 \mu\text{g}/\text{m}^3$, $0.22 \mu\text{g}/\text{m}^3$ and $0.14 \mu\text{g}/\text{m}^3$ respectively. The concentrations of PAH_8 in Dhaka north are lower than the concentrations in Dhaka south.

Clinical Chemistry

1.97 Quantifying Urinary Copper Levels in Human Urine Samples: A Diagnostic Approach for Wilson's Disease

T. R. Choudhury, M. N. E. Alam, M. A. Maksud, S. R. Khan, L. N. Lutfu, S. Sultana,

The objective of this work is to assess and quantify copper levels in urine samples as a diagnostic marker for Wilson's disease, aiming to contribute to the accurate detection and management of this genetic disorder affecting copper metabolism. Wilson disease is a rare, autosomal recessive disorder of copper metabolism,

often more prevalent in populations with high rates of consanguinity. First described by Kinnier Wilson in 1912, the disease involves over 500 mutations in the ATP7B gene, leading to impaired copper excretion and ceruloplasmin production, resulting in copper accumulation and toxicity primarily in the liver and brain. Clinical manifestations range from asymptomatic states to severe liver disease, acute liver failure, neuropsychiatric symptoms, and hemolytic anemia. Diagnosis relies on clinical signs, biochemical markers, histology, and genetic testing. Early detection remains crucial, especially in regions with a higher incidence of acute liver failure in children. Treatment includes copper-chelating agents like d-Penicillamine, trientine, and zinc salts, offering a favorable prognosis when initiated early. In the fiscal year July 2023 to June 2024, over 1,500 urinary samples were analyzed annually.

1.98 Molecular Characterization and Human Health Risk Assessment of Multi-Drug and Heavy Metals Tolerant Bacteria from Urban River Water

T. R. Choudhury, M. M. Kabir, M. N. E. Alam, M. A. Maksud, S. R. Khan, L. N. Lutfa, S. Sultana, M. S. Hossain

The present study characterized the multi-drug and heavy metal-resistant bacteria and their human health risks in the six major urban rivers. The bacterial strains were identified by molecular techniques based on 16 s rDNA gene sequence analysis, where most of the isolates belong to *Bacillus* spp. and *Staphylococcus* spp. In this study, the minimum inhibitory concentration (MIC) of the bacterial strains to different heavy metals like chromium, lead, cadmium, cobalt, mercury, and nickel ranged up to 3000 mg/L. The antibiotic susceptibility tests revealed that 69.23% of the strains resistant to ceftriaxone, while 61.54% were resilient to cefotaxime, 53.85% to ampicillin, 46.15% to amoxicillin, 30.77% to streptomycin, 15.38% to azithromycin, 15.38% to chloramphenicol, 7.69% to tetracycline, 7.69% to gentamycin, 7.69% to vancomycin. Interestingly, ciprofloxacin was found highly sensitive to all the bacterial strains in the present study. The multiple heavy metals resistance (MHMR) index of all the bacterial strains in the present study was very high compared to the standard value of 0.50. The multiple antibiotics resistance (MAR) index was highest for *Bacillus cereus* MKSMPbT1 (0.45), while it was lowest in *B. xiamenesis* MKSMCrB1 and *B. pumilus* MKSMNiT1 (0.09). The results of the hemolytic assay revealed that almost all the bacterial strains identified in the present study are highly pathogenic in nature. In essence, the bacterial strains identified in the present study could pose significant environmental and public health concerns that draw strict government attention.

1.99 Increase Serum Copper Level in Betel nut Chewer Oral Submucous Fibrosis Patient

T. R. Choudhury, A. Sultana, M. N. E. Alam, M. A. Maksud, S. R. Khan, L. N. Lutfa, S. Sultana

Oral submucous fibrosis (OSMF) is a precancerous condition of the oral cavity and categorized as potentially malignant disorder. Trace elements such as Copper, Iron, and Zinc play an important role in growth and maintaining the integrity of cells and tissues related to oral mucosa. The aim of this study was to examine the Serum Cu level in OSMF patients. This case-control study was carried out on 10 patients. OSMF patients were categorized by clinical and histopathological presentations and clinical staging. Flame Atomic Absorption Spectrometry was used to measure Serum copper level. Mean serum copper concentration was greater in study group compared to control group. The difference between Serum copper levels was statistically significant. Copper level was increased in OSMF patients and a gradual rise in copper level was noted with the advancement of clinical staging of OSMF who has exclusive history of betel nut chewing.

1.100 An Overview of Catechols Assessment of Dhaka City Using GC-FID and Impact on Radiative Balance

A. R. M. Tareq, R. Sultana, M. F. Ehasan and A. K. M. A. Ullah

Catechols are major constituents of atmospheric brown carbon. It readily converted to 4-Nitrophenol in atmospheric condition and having light absorbing characteristics both of them are considered hazardous and keep impact on environmental radiative balance. This study is for determination and quantification of catechol in the air aerosol of two distinct part of Dhaka city, Dhaka south and Dhaka north. PM_{2.5} Samples were collected for the analysis of catechol in aerosol from Dhaka city. Quartz filter were used for sampling in two points of Dhaka city using air sampler. Ethyl acetate and dichloromethane (1:1v/v) was used for the extraction of catechol deposited quartz filters. The extracted solution was evaporated using rotary evaporator for preconcentration to a certain volume for analysis and then analyzed using GC-FID where VF5ms column

was used for chromatographic separation. The study reveals that the concentration of Catechol in PM_{2.5} of Dhaka University area is greater than the concentration of Mirpur area. The average value for Catechol in monsoon, post monsoon and winter season in Dhaka University area are 2.17 µg/m³, 2.35 µg/m³ and 5.04 µg/m³ respectively and in Mirpur area are 1.44 µg/m³, 1.78 µg/m³ and 1.82 µg/m³ respectively. Air flow due to nearby Buriganga river, different industries of old Dhaka could be the possible reason for the greater values of catechols concentration in Dhaka south the Dhaka north whereas the two parts are over populated.

2. Manpower Development

Sl. No	Title of the program	Date	Place	Number of participants
1.	Virtual TC - Final Project Review Meeting	14-15 March, 2024	IAEA, Viena	1
2.	Joint ICTP-IAEA Workshop on Quality Assurance, Quality Control and Optimization of Equipment and Procedures Used in Fluoroscopically Guided Interventional Radiology	9-13 October, 2023	Trieste, Italy (Virtually)	1
3.	Follow-up Training Course on 'Reactor Engineering Course at BAEC (RECB-11) - 2023'	03-14 December, 2023	Training Institute, AERE, Savar, Dhaka	1
4.	Sensitization Workshop on Bangladesh National Single Window System	22 April, 2024	BRAC Center Inn, 75 Mohakhali, Dhaka	4
5.	Global Environmental Change & Remote Sensing Conference	16-19 September 2023	Wuhan, China	1
6.	Follow-up Workshop on AERSS Annual Meeting 2023	22 September 2023	Beijing, China	1
7.	1 st International Conference on Nano-bio and Advanced Materials Engineering 2023	07-08 January, 2023.	Cox's Bazar, Bangladesh	1
8.	International Conference on Physics – 2024	09 - 11 May 2024	AECD Campus, Bangladesh,	11
9.	Regional Workshop on the Development and Implementation of Effective Integrated Management Systems for Nuclear Facilities and Activities,	31 July - 04 August 2023.	Jakarta, Indonesia	1
10.	International Conference on Climate Change and the role of Nuclear Power: Atoms4NetZero,	9-13 October 2023	Vienna, Austria	1
11.	International Symposium on Food Safety and Control	27-31 May, 2024.	Vienna, Austria	1
	1st National Conference on Advances in Science and Technology	7 - 8 December, 2023	Dhaka, Bangladesh	1
12.	BCSIR Congress -2023	08-10 March 2024.	BCSIR Campus, Dhaka, Bangladesh	3
13.	Regional Training Course on Strategies and Design of Microplastics Monitoring Programs (TN-RAS7038-2302644)	04 - 15 February 2024	Safat, Kuwait	1
14.	IAEA-TC-RAS1030, "Using Radioisotope Techniques and Computational Fluid Dynamics Simulation for Troubleshooting and	28 August to 1 September 2023	Da Lat, Viet Nam	1

	Optimizing of Industrial Processes” Project Mid-Term Review Meeting, Da Lat, Viet Nam, from			
15.	Bangladesh National Training Course on Preventive and Protective Measures against Insider Threats to Nuclear Material	11-15 September 2023	Obninsk, Russian Federation	2
16.	Bangladesh National Training Course on Nuclear Security Recommendations on Physical Protection of Nuclear Materials and Nuclear Facilities	18-22 September 2023	Obninsk, Russian Federation	1
17.	Regional Training Course on Strategies and Design of Microplastics Monitoring Programs (TN-RAS7038-2302644)	04 - 15 February 2024	Safat, Kuwait	1
18.	Regional inception workshop on Reducing air pollution by creative use of palletization organized	07 -08 May, 2024	Dhaka, Bangladesh	1

3. Oral /Poster Presentation in Seminar/Symposium/Conference(National and International)

Name of the Participant	Title of oral/poster presentation	Title of the event	Organizer	Date	Place
Dr. Md. Safiur Rahman	Distribution and source apportionment of toxic and trace elements in some benthic and pelagic coastal fish species in Karnaphuli River Estuary, Bangladesh: Risk to human health	1st International Conference on Nano-bio and Advanced Materials Engineering 2023	Jessore University of Science and Technology	January 07-08, 2023	Jessore University of Science and Technology, Cox’s Bazar
	Emerging contaminants in drinking water distribution systems and their possible management and mitigation using nano materials	International Conference on Physics – 2024	Bangladesh Physical Society	09 - 11 May 2024	AECD Campus, Dhaka, Bangladesh
	Present Status of Nuclear Facilities for the Effective Integrated Management Systems for Nuclear Activities in Bangladesh	Regional Workshop on the Development and Implementation of Effective Integrated Management Systems for Nuclear Facilities and Activities	Badan Pengawas Tenaga Nuklir (BAPETEN)	31 July - 04 August 2023	Jakarta, Indonesia
	Modern nuclear energy to cut back on climate change mitigation costs	International Conference on Climate Change and the role of Nuclear Power: Atoms4NetZero	International Atomic Energy Agency (IAEA)	9-13 October 2023	Vienna, Austria

Name of the Participant	Title of oral/poster presentation	Title of the event	Organizer	Date	Place
	Characterization, source identification and hazard level assessment of ingested microplastics in one of the most important fish species in South Asia: <i>Oreochromis niloticus</i>	International Symposium on Food Safety and Control	International Atomic Energy Agency (IAEA)	27-31 May, 2024	Vienna, Austria
	Source apportionment of potential chemical composition in PM _{2.5} with especial emphasis on the impact of meteorological parameters along with health risk assessment in the capital city of Bangladesh	AERSS Annual Meeting 2023	Atmospheric Environmental Remote Sensing Society (AERSS)	16-19 September 2023	Wuhan, China
	Source apportionment of potential chemical composition in air pollutant with especial emphasis on the impact of meteorological parameters along with health risk assessment in the capital city of Bangladesh	University of Chinese Academy of Sciences	University of Chinese Academy of Sciences	22-Sep-23	Beijing, China
	Assessment and source apportionment of potential trace elements in PM _{2.5} with especial emphasis on seasonal variation in the capital city of Bangladesh	Atmospheric Composition and the Asian Monsoon (ACAM) Conference	National Aeronautics and Space Administration (NASA) and Atmospheric Composition and the Asian Monsoon (ACAM)	8-10 July 2023	Dhaka, Bangladesh
	Emerging contaminants in drinking water distribution systems and their possible management and mitigation using nano particles	1st National Conference on Advances in Science and Technology	BUET	7 - 8 December 2023	BUET, Dhaka, Bangladesh
	Environmental pollution in our daily life and its governance, management and mitigation	BCSIR CONGRESS - 2023	BCSIR	08-10 March 2024	BCSIR Campus, Dhaka, Bangladesh
	Study on the Change of PM _{2.5} and BC with the Variance of Climate in Dhaka	BCSIR Congress-2023	BCSIR	08-10 March 2024	BCSIR Campus, Dhaka, Bangladesh
Dr. Tasrina R.	Assessing Heavy Metal Levels in Spiny Lobster	International Conference on	BPS	9-11 May,	Dhaka,

Name of the Participant	Title of oral/poster presentation	Title of the event	Organizer	Date	Place
Choudhury	Species from the Bay of Bengal, Bangladesh: Implications for Consumer Health	Physics- 2024		2024	Bangladesh
	Microplastics unveiled: Recent perspectives on sustainable occurrence, characteristics, risk assessment, and sustainable management	BCSIR- Congress-2023	BCSIR	8-10 March 2024	BCSIR Dhaka
	Synthesis and Characterization of a Novel Metal–Phenolic Nanocomposite Sorbent for Efficient Arsenic Removal from Drinking Water	16th Asian Conference on Analytical Sciences (ASIANALYSIS XVI) 2023	-	9-12 October, 2023	Kuala Lumpur, Malaysia
Shirin Akter, Sazzadul Islam, Y. N. Jolly, Jamiul Kabir, K. M. Mamun, S. Hossain, Md. Joynal Abedin and A. Shelley	Evaluation of Pollutants in the Sediments and Fish Sample of Karnaphuli River and their Health Risk Assessment.”	International Conference on Physics – 2024	Bangladesh Physical Society	9 – 11 May 2024	AECD
Shirin Akter, Evana Akter, Yeasmin N. Jolly, Jamiul Kabir, S. Hossain, M. J. Abedin, K. M. Mamun, SK. Kalimullah, Nurjahan Rahman, Durjoy Kumar Baroy, Istiak Zaman Tanim, Md. Masud Rana and M. A. Rouf.	“Determining the Trace/Toxic Element Profiles in Raw Milk Commonly Available in Different Area of Bangladesh.”	International Conference on Physics – 2024	Bangladesh Physical Society	9 – 11 May 2024	AECD
Konica J. Fatema	Hydrogeochemical Evaluations of Groundwater and its Suitability for Irrigation	International conference on Physics -2024	Bangladesh Physical Society	9-11 May 2024	Atomic Energy Centre Dhaka
Dr. Md Shohel Rana	First Coordination Meeting of the Global Water Analysis Laboratory Network	IAEA		18-20 June, 2024	Vienna, Austria
A. R. M. Tareq, R. Sultana, M. F. Ehasan	Bio-Synthesis of silver nanoparticles (AgNPs) using <i>Momordica charantia</i> extracts to perceive the feasibility of its application as	5th International conference on ICPSPD 2023	CUET	7-8 September 2023	CUET

Name of the Participant	Title of oral/poster presentation	Title of the event	Organizer	Date	Place
	medicinal agent in different purposes.				
A. R. M. Tareq, R. Sultana, M. F. Ehasan	Phytosynthesis of silver nanoparticles (AgNPs) using <i>Ziziphus mauritiana</i> leaf extracts: Optimization of extraction and synthesis.	BCSIR Congress 2023	BCSIR	8-13 March 2024	BCSIR
A. R. M. Tareq, R. Sultana, M. F. Ehasan	Structural, optical and room temperature dilute magnetic semiconductor behavior of Co-doped ZnO nanomaterials for future spintronics applications.	BCSIR Congress 2023	BCSIR	8-13 March 2024	BCSIR
A. R. M. Tareq, R. Sultana, M. F. Ehasan	Cobalt doped ZnO Nanorods Preparation and Applications in Spintronics Depending on its Advanced Ferromagnetic Behavior	International Conference on Physics 2024	BPS	9-11 May 2024	AECD
A. R. M. Tareq, R. Sultana, M. F. Ehasan	Mn doped ZnO nanoparticles: Preparation and study of Structural and magnetic properties.	International Conference on Physics 2024	BPS	9-11 May 2024	AECD
A. R. M. Tareq, R. Sultana, M. F. Ehasan	Light absorption properties of BrC and identification of their precursors phenolic compound.	International Conference on Physics 2024	BPS	9-11 May 2024	AECD
M Nur E Alam	Assessment of isotopic signature ($\delta^{13}\text{C}$ & $\delta^{15}\text{N}$) in the most undisturbed sediment cores at Sundarbans mangrove area of Bangladesh in studies of sea level rise as well as heavy metal association with the isotopic ratio ($\delta^{13}\text{C}/\delta^{15}\text{N}$)	BCSIR-Congress-2023	BCSIR	8-10 March 2024	BCSIR Dhaka
Md. Abdul Mottalib Sarkar	Source identification of fine and coarse particulate matter in Dhaka, Bangladesh	International Conference on Physics-2024	Bangladesh Physical Society	09-11 May, 2024	AECD Campus, Dhaka, Bangladesh
	Seasonal variation of PM _{2.5} and black carbon and source apportionment of PM _{2.5} by using background trajectory approach	BCSIR Congress-2023	BCSIR	08-10 March 2024	BCSIR Campus, Dhaka, Bangladesh

Name of the Participant	Title of oral/poster presentation	Title of the event	Organizer	Date	Place
Mehedi Hasan	Status of fine particulate matter in Dhaka city and estimation of the respiratory deposition doses	International Conference on Physics-2024	Bangladesh Physical Society	09-11 May, 2024	AECD Campus, Dhaka, Bangladesh
	Identification of sources of fine and coarse particulate matter in Dhaka, Bangladesh	BCSIR Congress-2023	BCSIR	08-10 March 2024	BCSIR Campus, Dhaka, Bangladesh
	Seasonal characteristics and transport pathways of atmospheric black carbon over Dhaka city	BCSIR Congress-2023	BCSIR	08-10 March 2024	BCSIR Campus, Dhaka, Bangladesh

4. Stakeholder Meeting

Sl. No	Title of the program	Date	Place	Number of participants
1	Providing Services Aligned with ISO 17025 Accreditation in Analytical Chemistry Laboratory (ACL): Ensuring Quality and Compliance	14/05/2024	AECD	82
2.	A Facile Synthetic Route of Some Drug-like Molecules and Their Potential as SARS-Cov-2 and DPP-IV Inhibitors	27 June, 2024	AECD Auditorium	60

5. Collaboration work/ MOU (ADP/FNCA/MEXT/FTC/IAEA/RCA/TC/S&T/CRP/In-house project, Universities, etc.)

- IAEA/RCA RAS-7037 : Enhancing Wetland Management and Sustainable Conservation Planning (RCA)
- IAEA/TC RAS-1030 : “Using Radioisotope Techniques and Computational Fluid Dynamics Simulation for Troubleshooting and Optimizing of Industrial Processes”.
- RAS7038: "Monitoring the Marine Environment for Enhanced Understanding of the Abundance and Impact of Marine plastic Pollution.

5.2 Special Allocation (Grant) MOST Project

- Special Allocation Grant Project MOST (MOST- SRG-233439) of Ministry of Science & Technology entitled “Developing capacity for detection, occurrence and fate of emerging contaminants (metalloids and microplastics) in environments for mitigation and management of their probable ecological and human health risk”, (July 2023 to June 2024).

6. Service Rendered

SI No.	Name of service provided	Number/quantity of sample/patient / service	Revenue income (if any)
1.	Certification of purity and weight of Gold and Silver Medal/Crest/ Objects	451	991825/-
2.	Determination of Arsenic (As) in human scalp hair sample for the diagnosis of Arsenicosis Disease	130	121,000/-
3.	Analysis of sand samples for heavy metal content	10	52,000/-

SI No.	Name of service provided	Number/quantity of sample/patient / service	Revenue income (if any)
4.	Determination of heavy/ trace metal in Plant & Animal Tissue	4	6,200/-
5.	Determination of heavy/ trace metal in Water Solution & Powder	05	10,000/-
6.	Cu in Urine	1643	12,94,400.00
7.	Pb, Cu, Zn in Serum	13	18,000.00
8.	Pb, Cr in Poultry Feed	43	1,72,000.00
9.	Pb in Milk	16	32,000.00
10.	Pb, Cd, Cr in Herbal Powder	2	12,000.00
11.	Pb, Cd, Cr in Ash	2	12,000.00
12.	Pb, Ni, Cr, Co, Mn, Fe, Zn, As, Cu in Sulfuric Acid	1	18,500.00
13.	Pb and Cr in Oil	1	5,000.00

Electronics Division, AECD

Objective

Electronics division has been providing services through repair and maintenance of various types of scientific, medical, analytical and nuclear instruments belonging to all divisions of AECD. The division also provides the repair and maintenance of computer, Intercom, CCTV and Solar pumping systems of AECD. Besides, the division has contributed to research and development works in the fields of IOT based embedded system, PC based system, FPGA based system, Machine learning, and Robotic system to facilitate nuclear and analytical research activities at AECD. This division is also engaged in manpower development through training, research collaboration etc. The major programmes of the Division are as following:

- Repair, Maintenance and Installation
- Training and Manpower Development
- Development of Advanced Electronics based Instrumentation
- Applications of Robotics in Nuclear Power Plant (NPP) and other Nuclear Establishments

1. Research and Development Work(s)

1.1 Development of Robot for Nuclear Facilities

M. A. A. Mamun, M. A. Rahman, S. Sattar, M. T. Khatun, A. Begum and M. Begum

Increasing demand has led to the usage of nuclear technologies in the domains of electricity, healthcare, industry, academia, and research. Accordingly, there are many nuclear facilities in Bangladesh, like research reactors, isotope generators, gamma irradiators, nuclear medicine centers, etc. It is the key concern to protect the radiation workers from unwanted radiation exposure. To help with routine tasks like area monitoring, source handling, inspection, and maintenance, as well as post-accident rehabilitation, robots or robotic systems can play a vital role and must be introduced in nuclear facilities. The objective of this work is the development of robot for nuclear facilities to do tasks like surveillance and radiation monitoring.

In this work, a robotic system that is employed for remotely detection and monitoring of nuclear radiation, acquiring and storing of radiation data around the nuclear facilities of Bangladesh. The robotic system is designed as an unmanned ground vehicle (UGV), where an Internet of Things (IoT) based technique facilitates the system not only to acquire the radiation data, but also distribute it to the cloud server through internet. The distributed radiation data can be monitored and stored for the utilization of in the nuclear emergency response and preparedness system. It will be also helpful to ensure safety of the human workers from unwanted radiation exposure, by assisting them with remote detection and handling of radioactive source, monitoring of radiation levels at hazardous locations, where human presence should be limited.

1.2 Development of IoT Based Robotic Arm System

M. A. A. Mamun, M. A. Rahman, S. Sattar, M. T. Khatun, A. Begum and M. Begum

A robotic arm is a multipurpose, reprogrammable manipulator designed to help humans in a variety of environments. It can outperform humans at monotonous tasks like pick-and-place work. In order to address the issue of human inefficiency, industrial production and assembly have extensively integrated robotic arms into their assembly lines. The realization of smart industry is made possible through the combination of robotic arms and the internet of things. The objective of this work is to develop an IoT-based robotic arm system with six degrees of freedom and a mechanical gripper.

This work presents the development of a robotic arm system that is based on the Internet of Things (IoT). The direction of the robotic arm can be monitored and controlled using IoT facilities. The NodeMCU board is used for the robotic arm controller as well as the web server system. The robotic arm comprises six servo motors, and each of the servo motors is assigned a single pulse width modulation (PWM) output that can be individually controlled. The controller system is implemented on a NodeMCU board using the Arduino programming language. Wi-Fi is used to communicate with the robotic arm controller via the Blynk smartphone app. Arm movement and pick-and-place operations can be carried out by the robotic arm remotely using an Android mobile smartphone.

1.3 Development of IoT based Soil Quality Monitoring System for Smart Agriculture

M. A. A. Mamun, M. A. Rahman, S. Sattar, M. T. Khatun, A. Begum, M. Begum, F. Rahman* and A. Mustafi*

Soil quality plays a pivotal role in agricultural productivity. Factors such as moisture content, humidity, temperature, and nutrient composition profoundly influence crop growth and health. Traditional methods of soil analysis often involve labor-intensive sampling and testing, which are time-consuming and may not provide real-time feedback. In recent years, the integration of Internet of Things (IoT) technologies has revolutionized various industries, including agriculture. One of the significant advancements facilitated by IoT is the development of Soil Quality Monitoring Systems. These systems leverage sensors, connectivity, and data analytics to provide farmers with real-time and historical insights into soil conditions, thereby optimizing agricultural practices and enhancing crop yield. The objective of this work is to develop an IoT-based Soil Quality Monitoring System for smart agriculture.

In this work, the development of an IoT-based Soil Quality Monitoring System has been presented. The developed system is compact, easy to handle, portable, robustness, access anywhere to get data and economically benefited. The design and construction of the system are performed by using components like NodeMCU, Moisture sensors, NPK sensor, DHT11 sensor, OLED Display, mobile app, and web server. The system is involved for continuously monitoring of key soil parameters using a network of sensors embedded in the soil. These sensors collect data at regular intervals, which is then transmitted wirelessly to a central system or cloud platform for analysis. Farmers can access this data through user-friendly interfaces such as mobile apps or web dashboards, enabling them to make informed decisions promptly. Thus, IoT-based Soil Quality Monitoring System represents a transformative approach to modern agriculture, empowering farmers with actionable insights to maximize productivity and sustainability.

*Department of Electrical and Electronics Engineering (EEE), University of Dhaka.

1.4 Simultaneous Localization and Mapping (SLAM) of an Autonomous Mobile Robot (AMR) Using LiDAR

M. A. Rahman, M. A. A. Mamun, S. Sattar and M. Begum

Autonomous mobile robots are becoming more prominent in recent times because of their relevance and applications to the world today. Autonomous mobile robots are emerging in different sectors such as industry, agriculture, military, medicine, education, research, etc. to improve services and daily activities. An autonomous mobile robot is a robot that is designed and engineered to deal with its environment on its own and work for extended periods without human intervention. Autonomous robots use sophisticated sensors, artificial intelligence, machine learning, and computing for path planning to interpret and navigate their environment. The present work aims to implement a mapping method to create a map for an autonomous robot to navigate an unknown environment independently.

In this work, the LiDAR SLAM method is proposed for mapping an unknown indoor environment among the various SLAM methods such as visual SLAM, LiDAR SLAM, multi-sensor SLAM, etc. LiDAR SLAM, or Light Detection and Ranging Simultaneous Localization and Mapping, is a process that relies on LiDAR sensors and enables robots or autonomous systems to build a map of an unknown environment. LiDAR SLAM has gained popularity in recent years, due to its versatility and applications across various domains, including autonomous vehicles, mobile robotics, and indoor mapping. Simultaneous localization and mapping (SLAM) is a method that applies a sophisticated algorithm to allow the vehicle to map out unknown environments. Two technology components are used to achieve SLAM: sensor signal processing and pose-graph optimization. The map information is further used for path planning and obstacle avoidance tasks. This is an ongoing work.

1.5 IoT-Based Nutritional Parameter Monitoring and Control System for Hydroponics Farming

M. A. Rahman, M. A. A. Mamun, S. Sattar and M. Begum

Hydroponics farming is gaining popularity worldwide as it can provide high-quality, healthy, fresh, residue-free vegetables and fruits locally. Hydroponics is a soilless crop-growing method with the benefits of controlling the environment and nutrients, conserving water, and reducing labor. In hydroponics, it is possible to increase production rate (2X, 3X, and in some cases more) with reduced time than traditional soil-based farming, with proper control of the various nutritional and environmental parameters. This work aims to design an IoT-based nutritional parameter monitoring and control system for hydroponics farming.

In a hydroponic system, potential hydrogen (pH), electrical conductivity (EC), dissolved oxygen (DO), and temperature are some essential parameters (factors) of the nutrient solution that must be carefully monitored and controlled for the proper growth of plants. All these factors play an important role in ensuring a comfortable, healthy environment for growing plants. In this work, an IoT-based nutritional parameter monitoring and control system is proposed that will be able to monitor and control pH, EC, DO, and temperature of nutrient solution locally and remotely. To achieve this, a pH sensor, an EC sensor, a DO sensor, and a temperature sensor will be interfaced with Arduino for local monitoring and control of various nutritional parameters. For remote monitoring and control an IoT-device (ESP32) will be used. This is an ongoing work.

1.6 Path Planning Approach Based on Q Learning for Robots

S. Sattar, M. A. A. Mamun, M. A. Rahman, M. T. Khatun, A. Begum, M.U. Safia, S. Sultana and M. Begum

Path planning is one of the most popular research works for mobile robots, which is very important for the implementation of autonomous navigation in robots, and Q-learning is a popular model in robot path planning, as it requires the interaction between the current state and the environmental condition to make decisions on the next action. The objective of the work is to study the basic Q learning algorithm and its parameters for mobile robot path planning.

The Q-learning algorithm is a mode of reinforcement learning. This algorithm has the advantages of independent planning in an unfamiliar environment, adequate planning time, and optimal planning path. It is also suitable for the obstacles with volume and height in the actual environment, and the autonomous navigation of the robot has a higher use value. The interactive mode makes the mobile robot more adaptable to the path planning in the static environment of complex obstacles. In this method, the mobile robot is not initially trained. Based on strategy and learning, it takes different steps to get different feedbacks, and to find the next action that can get the desired result. Through the interaction with the environment, the mobile robot can obtain feedback information from the environment, optimize the decision, and finally obtain the overall optimal strategy. This optimal strategy will be compared with other algorithms to find out the Q-learning algorithm's feasibility.

1.7 Development of an IOT Based Air and Sound Quality Detection System for Environmental Monitoring

M. T. Khatun, A. Begum, M. A. A. Mamun, M. A. Rahman, S. Sattar, M. U. Safia, S. Sultana and M. Begum

An increasing number of people, more vehicles being driven, industrialization, and urbanization are some of the reasons contributing to the environment's increasing pollution levels. Air and sound pollution are becoming significant issues in the environment because they can cause numerous illnesses, including mostly cancer, asthma, sinus infections, coronary heart sicknesses, and eye troubles. To ensure healthy living surroundings for everyone, it is very vital to develop an effective monitoring system that can detect and monitor the air and sound quality of the environment. The objective of this research work is to develop an IOT based monitoring system for detecting and monitoring air and sound quality of the environment.

In this work, five sensors, such as LM-393, DHT-11, MQ135, MQ2, and MQ9, have been used to detect sound quality, temperature, pressure, humidity, and air quality. Here, LM-393 and DHT-11 were utilized to find out the sound quality, temperature and humidity, respectively. Additionally, there are numerous MQ series sensors, of which MQ135, MQ2, and MQ9 are the gas sensors used to detect the presence of alcohol, CH₄ and CO, respectively in the air to find out the air quality. An analog voltage is generated across the sensor when the amount of gases in the air changes. After that, the generated voltage is fed into the microcontroller, which converts the value into PPM. The PPM values for all gases are displayed on an LCD and these values are assigned as “Safe”, “Moderate” and “Harmful” based on the concentration of each gas, where “Safe” status means the concentration of harmful gas is low, “Moderate” status means the concentration of harmful gas is medium, and “Harmful” status indicates a high concentration of harmful gas. In addition, a WiFi module (ESP-8266) has been used to display results and analyze them on a server named “ThingSpeak”. Finally, a piezo buzzer has been used to give an alarm when the gas concentration status becomes “Harmful”. The prototype system has been developed and tested in our laboratory, which gives satisfactory results. The whole developed system as a portable device will help to identify environmental conditions at any time and will be more user-friendly compared to existing environmental monitoring systems.

1.8 Effective Stroke Prediction Model using Supervised Machine Learning Algorithms

A. Begum, M. A. A. Mamun, S. Sattar, M. A. Rahman, M. T. Khatun, S. Sultana and M. Begum

Stroke is one of the leading causes of death around the world. The main reason for death by stroke is not taking prevention measures early and not understanding stroke. As a result, death by stroke is thriving all over the world, especially in developing countries like Bangladesh. Steps must be taken to identify strokes as early as possible. In this case, machine learning can be a solution. This study aims to determine the appropriate algorithms for machine learning to predict stroke early and accurately and identify the main risk factors for stroke.

In this work, a real dataset was collected from the Kaggle website and split into two parts: train data and test data, and seven machine learning algorithms such as Random Forest, Decision Tree, K-Nearest Neighbor, Adapting Boosting, Gradient Boosting, Logistic Regression, and Support Vector Machine were applied to that train data. Performance evaluation was calculated based on six performance metrics accuracy, precision, recall, F1-score, ROC curve, and precision-recall curve. To figure out the appropriate algorithm for stroke prediction, the performance of each algorithm was compared, and it was found that Random Forest was the best performing algorithm with 0.99 accuracy, precision, recall, F1-score, an AUC of 0.9925 for the ROC curve, and an AUC value of 0.9874 for the precision-recall curve. Finally, feature importance scores for each algorithm were calculated and ranked in descending order to find out the top risk factors for stroke, like ‘age’, ‘avg_glucose_level’, ‘bmi’, ‘hypertension’, and ‘smoking_status’. The developed model can be used in different health institutions for stroke prediction with high accuracy.

1.9 IoT-based Vehicle Accident Prevention and Alert System

A. Begum, M. A. A. Mamun, S. Sattar, M. A. Rahman, M. T. Khatun, S. Sultana and M. Begum

Every year, a huge number of deaths occur due to vehicle accidents in Bangladesh. For this reason, the main objective of this work is to develop an accident prevention system and an alert system that will help prevent accidents and provide messages to the nearest police station and medical institute.

In this system, we have used a Node MCU, a tilt and vibration sensor, and an ultrasonic sensor with a GSM and GPS module. In this study, our main target is to develop a system that will be able to communicate with

the nearest police station and health clinic after an accident occurs. In this regard, we interfaced the Node MCU with a tilt and vibration sensor to detect accidents, and a GSM and a GPS module were interfaced to identify the location and send a call and message to the nearest police station and hospital. To prevent accidents, an ultrasonic sensor will be interfaced with the node MCU, which will be able to measure the distance from other vehicles (front and back of the installed vehicle). When a car comes across that vehicle and the distance is so close that an accident can occur, the driver will receive an alarming sound with a buzzer. This is an ongoing project, and it is considered that further development of this work will help to provide an accident alert and prevention system.

2. Manpower Development

Title of the Program	Date	Place	Number of Participants
Industrial Attachment Training program	16/08/2023 - 07/11/2023.	Electronics Division, AEC, Dhaka	26

2. Stakeholder Meeting

Sl.No	Title of the program	Date	Place	Number of participants
01.	Industrial Attachment Training Program: Opportunities and Challenges on zoom	04-06-2024	Auditorium, AECD	33

3. Collaboration work /MOU (ADP/FNCA/MEXT/FTC/IAEA/RCA/TC/S&T/CRP/In- house project, Universities, etc)

- Project under Special Research Grant 2023-2024 of Ministry of Science and Technology, titled Development of Robot for Nuclear Facilities (SRG-232366)
- This division is involved with the collaboration research work with different National & International universities.

4. Service Rendered

During this period, various scientific, medical, nuclear, and analytical instruments have been repaired as shown in the table 1. The major instruments include Water Bath, Laptop, Microwave Oven, UPS, and Printer. This division also provides successful maintenance of computer, intercom, CCTV, digital attendance, and internet system of AECD.

Table 1: Type and number of instruments are repaired

Sl no.	Name of service provided	Number/quantity of sample/patient/service
01.	Scientific, Nuclear and Analytical	02
02.	Computer (System Unit with software installation)	19
03.	UPS	01
04.	Printer	02
05.	Microwave Oven	01
06.	Intercom System (Line & Set)	02

Experimental Physics Division

Objective

Experimental Physics Division (EPD) of Atomic Energy Centre, Dhaka (AECD) is involved in research and development activities in both fundamental and applied fields of science and technology. EPD concentrates in the field of thin film technology as the amount of material needed in thin films is drastically reduced compared to bulk materials; and thereby, to bring down the cost in technological issues. The members of Division are devoted to study of preparing, characterizing and developing some technologically important

photo voltaic thin film materials and is therefore, economically advantageous for photovoltaic (PV) applications like as solar cell. Recognizing the aforementioned situations and to address them, the EPD Division has set its aims to develop and characterize the solar energy materials and advanced materials in thin film form for photovoltaic, optoelectronic and nuclear detector applications.

1. Research and Development Works

1.1 Synthesis and Characterization of Undoped Zinc Selenide and Al Doped Zinc Selenide by Thermal Evaporation Technique

K. M. A. Hussain, T. Faruque, J. Parvin, F. T. Z. Toma and S. Ahmed

Analysis of structural, optical, elemental and electrical properties of ZnSe and Al doped ZnSe thin films.

Undoped, and 1%, 1.50%, 2%, 2.5% Al doped ZnSe Thin film were prepared by thermal evaporation technique. ZnSe thin films of thickness 500 nm & substrate temperature $S_T = 250^\circ\text{C}$ & annealing temperature $A_T = 230^\circ\text{C}$ with annealing time 1 hour is prepared by thermal evaporation method. Optical properties were characterized by UV-VIS-NIR spectroscopy. The most important parameter optical band gap estimated on this research work. Structural parameters such as crystallite size, stress, strain, dislocation density was obtained from the XRD data using different models. Elemental measurement was observed by FTIR. ZnSe films thickness were calculated and synthesis and Analysis of the parameters are going on.

1.2. Optical Properties of ZnSe and Ag Doped Thin Films Using Thermal Evaporation Technique

K. M. A. Hussain, T. Faruque, J. Parvin, F. T. Z. Toma and S. Ahmed

Analysis of optical properties of ZnSe and Ag doped ZnSe thin films.

Undoped, and 1%, 1.50%, 2%, 2.5% Ag doped ZnSe Thin film were prepared by thermal evaporation technique. ZnSe thin films of thickness 500 nm & substrate temperature $S_T = 250^\circ\text{C}$ & annealing temperature $A_T = 230^\circ\text{C}$ with annealing time 1 hour is prepared by thermal evaporation method. Optical properties were characterized by UV-VIS-NIR spectroscopy. The most important parameter optical band gap estimated on this research work. Structural parameters such as crystallite size, stress, strain, dislocation density was obtained from the XRD data using different models. XRD data confirmed the structure of the synthesized thin films which is in accordance with the SEM image. Particle Size and strain were estimated using Debye-Scherrer. Average size of the particles was found to be in the range of nm. The size distribution of nanoparticles were also observed from SEM images. Elemental measurement was observed by FTIR. ZnSe films thickness were calculated and synthesis and Analysis of the parameters are going on.

1.3 Deposition and Characterization of SnS₂ Thin Films by Spin Coating Deposition Technique

K. M. A. Hussain, T. Faruque, J. Parvin, F. T. Z. Toma, S. Ahmed and J. A. Jahan

To observe the SnS₂ thin films and also measure the parameters of the samples.

Tin di-sulfide (SnS₂) thin films were synthesized by Spin coating method. SnS thin films are deposited on glass substrate. Thin films were prepared at room temperature for 1500 rpm/30sec & annealing temperature $A_T = 1000^\circ\text{C}$, 4000°C for 15 min. Annealing temperature significantly influenced crystallinity and surface roughness of the thin films in spin coating method. These films may be a good candidate for suitable application in various optoelectronic devices. One research article is published on this work.

1.4 Deposition and Characterization of Fe doped SnS₂ Thin Films by Spin Coating Deposition Technique

K. M. A. Hussain, T. Faruque, J. Parvin, F. T. Z. Toma and S. Ahmed

To observe the Fe doped SnS thin films and also measure the parameters of the samples.

Tin di-sulfide (SnS₂) thin films were synthesized by Spin coating method. SnS and Fe (0%, 5%, 7%, 9%) doped SnS thin films are deposited on glass substrate. Thin films were prepared at room temperature for 1200 rpm/30sec & annealing temperature $A_T = 100^\circ\text{C}$, for 15 min. After repeating 3 times again annealed at $450^\circ\text{C}/1\text{hour}$. Annealing temperature significantly influenced crystallinity and surface roughness of the thin films in spin coating method. The structural optical, elemental, and optical information were investigated by

X-ray Diffraction (XRD), FTIR, UV-VIS-NIR spectroscopy, respectively. These films may be a good candidate for suitable application in various optoelectronic devices. Analysis of the parameters is going on.

1.5 Synthesis of Mn doped ZnSe Thin Film by Thermal Evaporation Method

K. M. A. Hussain, T. Faruque, J. Parvin, F. T. Z. Toma, S. Ahmed and Q. Zaman

Analysis of structural, optical, elemental and electrical properties of Mn doped ZnSe thin films. 1%, 1.5%, 2%, 2.5% Mn doped ZnSe Thin film were prepared by thermal evaporation technique. ZnSe thin films of thickness 500 nm & substrate temperature $S_T = 250^\circ\text{C}$ & annealing temperature $A_T = 230^\circ\text{C}$ with annealing time 1 hour is prepared by thermal evaporation method. Optical properties were characterized by UV-VIS-NIR spectroscopy. The most important parameter optical band gap estimated on this research work. Structural parameters such as crystallite size, stress, strain, dislocation density was obtained from the XRD data using different models. Elemental measurement was observed by FTIR. ZnSe films thickness were calculated and synthesis and Analysis of the parameters are going on.

1.6 Investigation of the Structural, Morphological and Optical Properties of ZnCdS Thin Film thin films by Chemical Bath Deposition Method

K. M. A. Hussain, T. Faruque, J. Parvin, F. T. Z. Toma, S. Ahmed and Q. Zaman

To observe the effect of ZnCdS Thin Film thin film and measure the parameters of this films.

The effects of undoped and Sn doped concentrations on the optical, structural and morphological properties of CdSe films are observed. The thin films of ZnCdS Thin Film have been grown on glass substrates using CBD at 80°C temperature for 1 hours with annealing temperature 200°C & time 1 hour. From X-ray diffraction patterns it was found that cubic phases preferred orientation along 111 plane. Thickness of all samples were measured and found near nm range. The optical transmittance, absorbance and band gap of these films were determined using UV-VIS-NIR Spectrometry. It was also observed that the band gap decreases with increasing Sn doping concentration. FTIR spectra confirmed the successive formation of ZnCdS thin film samples.

1.7 Synthesis and the Structural Analysis of $\text{Cd}_{0.6}\text{Zn}_{0.4}\text{S}$ Thin Film using Chemical Bath Deposition (CBD) Technique

T. Faruque, K. M. A. Hussain, J. Parvin, F. T. Z. Toma, S. Ahmed and Q. Zaman

To observe the effect of $\text{Cd}_{0.6}\text{Zn}_{0.4}\text{S}$ Thin Film thin film and measure the parameters of this films.

The structural and optical properties of CBD deposited $\text{Cd}_{0.6}\text{Zn}_{0.4}\text{S}$ thin films have been studied by varying the processing parameters and ratio of the starting Precursors in order to better understand the growth conditions. The $\text{Cd}_{0.6}\text{Zn}_{0.4}\text{S}$ thin films were prepared on glass substrate by CBD from a bath containing. The structural analysis was performed by XRD. The deposited $\text{Cd}_{0.6}\text{Zn}_{0.4}\text{S}$ thin film was a cubic phase with small nano crystalline grains. The film was deposited at 80°C for 1 hours. After sintering the film at 100°C for 10 minutes and the thickness of the film was obtained 100 nm. These studies have allowed us to establish a standard set of conditions for the fabrication of homogeneous and continuous very thin $\text{Cd}_{0.6}\text{Zn}_{0.4}\text{S}$ films in laboratory.

1.8 Investigation of the Effect of the Annealing Temperature on as Prepared CdS Nano Powder and Commercial Nano Powder Synthesized by Chemical Precipitation Technique

T. Faruque, F. T. Z. Toma, K. M. A. Hussain, J. Parvin, and S. Ahmed

To observe the CdS Nano particles also measure the parameters of the samples.

Cadmium Sulfide (CdS) nano particles are synthesized by chemical precipitation method. Cadmium Chloride and Thiourea are used as the precursor materials. Ammonia water & distilled water are used as solvent. The samples are annealed at 100°C , 300°C and 500°C for 1 hour. Transmission electron microscopy (TEM), Energy-dispersive X-ray spectroscopy (EDAX), and X-ray diffraction pattern (XRD) are used to study the morphologies, distribution, and crystallinity of the as prepared and commercial CdS nano powders and to calculate the values of their sizes. The results indicate that the CdS are formed with Hexagonal structure and the particle size varies with the Cd^{+2} ions. Synthesized nano particles show structural properties after

annealing. The particles are in high degree of crystallization. The XRD results reveal that the annealing effect has increased the crystalline size of the CdS nanoparticles. TEM demonstrates that the average sizes of spherical cadmium sulfide nano particles at annealing temperature of 100°C, 300°C and 500°C respectively. In this research CdS has been studied due to its potential technological applications in field effect transistors, solar cells, photovoltaic devices, light emitting diodes, photo catalysis, photoluminescence, infrared photo detector, environmental sensors, biological sensors etc.

1.9 Effects of Gamma Irradiation on Structural and Optical Properties of BaTi_{0.5}Fe_{0.5}O₃ Ceramic Composite Material for Storage Device Applications

F. T. Z. Toma, K. M. A Hussain, T. Faruqe, J. Parvin, and S. Ahmed

To observe the BaTi_{0.5}Fe_{0.5}O₃ composite Material and also measure the parameters of the samples.

The effect of gamma irradiation on hydrothermally synthesized BaTi_{0.5}Fe_{0.5}O₃ composite materials has been investigated. Barium Titanate synthesized by solid state reaction method and all the samples pre-sintered and sintered at 800°C, 1200 °C/3 h. Gamma irradiation was carried out at room temperature from 0, 25, 50, 75 kGy to a maximum dose and source being used as ⁶⁰Co gamma radiations. Optical properties were characterized by UV-VIS-NIR spectroscopy. The most important parameter optical band gap estimated on this research work. Structural parameters such as crystallite size, stress, strain, dislocation density was obtained from the XRD data using different models. Elemental and Morphological measurement was observed by FTIR and SEM. Other Characterization and Analysis of the parameters are going on.

1.10 Synthesis and Characterization of Cu Doped CdS Thin Films by Spin Coating Technique

T. Faruqe, F. T. Z. Toma, K. M. A Hussain, J. Parvin, and S. Ahmed

To observe the Cu doped CdS thin films and also measure the parameters of the samples.

Undoped CdS and 5%, 7%, 9% Cu doped CdS thin films are deposited on glass substrate at $r.p.m = (2000, 5000)/30 \text{ sec}$ & Annealing temperature 150°C for 30 minute and 1 hour. UV measurements of these films were completed and Phase analysis of the doped and undoped were done by XRD. SEM, confirmed the morphological structure of the films. These films may be a good candidate for suitable application in various optoelectronic devices. Analysis of the parameters is going on.

1.11 Synthesis and Characterization of CdS Single Crystal by Chemical Bath Deposition Technique

F. T. Z. Toma, K. M. A Hussain, M. T. Chowdhury, T. Faruqe, J. Parvin, and S. Ahmed.

Synthesis & characterization of CdS single crystal.

Synthesis and growth of Cadmium Sulfide (CdS) single crystal produced by very easy and low cost Chemical Bath Deposition technique. In this study single crystal of CdS were grown up in room temperature and from aqueous solution by CBD technique at 60°C temperature for 2 hours using Cadmium Chloride (CdCl₂), Ammonia water (NH₄OH), Thiourea [CS(NH₂)] and Distilled water as solvents respectively. It was observed that the Cadmium Chloride and Ammonia water form a complex species of [Cd(NH₃)₄]₂ to slow release of Cd²⁺ metal ion mode in crystal. Structure analysis of CdS single crystal was carried out by X-ray diffraction technique. Scanning Electron Microscopy (SEM) was used to Characterized the surface morphology and EDX (a analysis tool of SEM) used for elemental analysis which confirmed all the element present in the CdS single crystal. The FTIR spectrum confirms the existence of Cadmium Sulfide compound and water molecules in the samples. In this observation CBD method producing dispersive and crystalline CdS single crystals in the aqueous phase would have important applications because it provides hydrophilic crystals and is environmentally friendly. Others measurement and analysis of the parameters are going on.

1.12 Study of Thyroid Disease in Pregnancy: A Review Research Work

F. T. Z. Toma, K. M. A Hussain, M. T. Chowdhury, T. Faruqe, J. Parvin, and S. Ahmed.

These Review research work highlight the complexities involved in thyroid disorder detection strategies and suggest potential benefits in targeted treatment interventions following screening in specific risk groups.

Pregnancy-related thyroid conditions, the second most prevalent endocrine disorders following diabetes, demand effective management to mitigate adverse consequences for both mother and fetus. Thyroid disease is associated with obstetric and child development complications, necessitating consideration from clinical and scientific viewpoints. This review consolidates current knowledge on thyroid disease in pregnancy, encompassing management, physiological changes, pathological functions, diagnosis, and treatment. Physiological alterations include thyroid stimulation by hCG, placental expression of deiodinases, and increased thyroid vascularity. Hypothyroidism, occurring in 0.6% of pregnancies, poses risks if untreated. Hyperthyroidism, affecting 0.2%, demands careful diagnosis due to TSH suppression in early pregnancy. Adverse outcomes include preterm labor, low birth weight, and impaired neurodevelopment. Post-delivery, monitoring and adjusting levothyroxine are essential, and anti-thyroid drug risks must be considered. Fetal and neonatal outcomes, influenced by maternal TRAb levels, require vigilance. Iodine's role in pregnancy, especially deficiency implications, underscores the importance of monitoring and supplementation. Postpartum care includes thyroid function tests and addressing postpartum thyroiditis, impacting 8% of women. Breastfeeding with antithyroid drugs requires cautious consideration, ensuring minimal impact on neonatal thyroid function. Screening for thyroid disorders during pregnancy remains debated, with case-finding limitations. Despite inconclusive evidence, levothyroxine supplementation may be considered for TPO Ab-positive euthyroid pregnant women with a history of miscarriage. Effective management, early diagnosis, and tailored care contribute to improved maternal and fetal health, emphasizing the need for continued research and evidence-based guidelines. One research review article is published on this work.

1.13 Effect of Stabilizer Content in Different Solvents on the Synthesis of ZnO Nanoparticles Using the Chemical Precipitation Method

F. T. Z. Toma, K. M. A. Hussain, M. T. Chowdhury, T. Faruque, J. Parvin, and S. Ahmed.

Analysis of optical & structural properties of ZnO Nano powder.

Zinc Oxide (ZnO) nanoparticles (NPs) have been synthesized by a simple chemical precipitation method. The effect of monoethanolamine (MEA) content in different solvents on ZnO NPs synthesis and their structural properties has been investigated. The NPs synthesized by using isopropanol (IPA) with 15 ml MEA as a stabilizer under the most favorable conditions (deposition time, $t_d = 120$ min, temperature = 60°C) showed good structural properties. Synthesized NPs exhibited beneficial structural properties after annealing. The hexagonal wurtzite crystal structure of ZnO NPs was verified by XRD. Different models were used to calculate structural parameters such as crystallite size, strain, stress, and energy density for all the reflection peaks of XRD corresponding to ZnO lying in the range $2\theta = 15^\circ\text{-}80^\circ$. The crystallite size of the ZnO nanoparticles was found to be 50-60 nm. FTIR and EDX confirmed the presence of ZnO NPs in the samples. SEM micrograph of all the samples revealed that the grain sizes decrease gradually with the increase of the amount of MEA. UV-Visible diffuse reflectance spectroscopy results provide evidence that the ZnO NPs possess broader absorption bands, together with high band gap energy. The ZnO NPs synthesized with IPA solvent have the highest transmittance and band gap energy of 3.3eV. According to DLS data, various content of MEA stabilizer in solvent affects the hydrodynamic size of ZnO NPs. One research review article is published on this work.

1.14 Exploring the Influence of Iron Doping on Structural, Morphological and Optical Properties of Chemical Bath Deposited Cadmium Selenide Thin Films for Optoelectronic Applications

F. T. Z. Toma, K. M. A. Hussain, M. T. Chowdhury, T. Faruque, J. Parvin, and S. Ahmed

This research contributes to the advancement of knowledge in the field of semiconductor materials by providing valuable insights into the synthesis and characterization of Fe-doped CdSe thin films. By elucidating the relationship between doping concentration and film properties, we aim to pave the way for the development of enhanced semiconductor materials for a variety of technological applications

This research investigates the structural, morphological, and optical properties of Cadmium Selenide (CdSe) thin films deposited via the Chemical Bath Deposition (CBD) Technique, focusing on the impact of Iron (Fe) doping. Using Cadmium Chloride (CdCl_2) and Ferrous chloride (FeCl_2) as precursor materials, the research investigates how Fe doping affects the structural and photoelectric characteristics of the films. Employing various characterization methods including X-ray Diffraction (XRD), Scanning Electron Microscopy (SEM),

Fourier-Transform Infrared Spectroscopy (FTIR), and UV–Vis NIR spectroscopy, the study provides a comprehensive analysis of the films. XRD analysis confirms the formation of a cubic structure with a predominant orientation along the (111) plane, consistent with XRD peaks. Additionally, XRD data reveals the degradation of thin films post-annealing. Crystalline size and strain are determined using the Debye-Scherrer and Wilson formulae, while lattice constant and Size-strain plots are derived from X-ray line broadening. The average crystallite size ranges from 12 to 21 nm. Optical band gaps are found to be 2.25 eV, 2.91 eV, 2.87 eV, and 2.85 eV for the samples. Interestingly, a decrease in crystal size with increasing doping concentration correlates with a reduction in bandgap. This investigation offers valuable insights into the fabrication and characterization of CdSe thin films, particularly highlighting the impact of Fe doping on their structural and optical properties. Overall, this study provides valuable insights into the fabrication and characterization of CdSe thin films, emphasizing the importance of precise doping control for tailoring material properties and advancing their applications in photovoltaic and optoelectronic devices. One research article is published on this work.

2. Manpower Development (Training/Fellowship/Workshop/Meeting)

2.1. Attended in Training/Fellowship/Workshop/Meeting

Sl. No	Title of the program	Date	Place	Number of participants
01	Bangladesh National Training Course on Preventive And Protective Measures Against Insider Threats To Nuclear Facilities. Tania Faruqe, Held in Obninsk, Russian Federation, organized by Technical Academy ROSATOM.	11-15, September, 2023	Held in Obninsk, Russian Federation,	01
02	Live International Workshop in “Writing Review Paper using Artificial Intelligence: Current Risks and Benefits” Organized by Global research, Education and Event Network (Green).	30/06/2023	zoom platform	01
03	“Neuro Logistic Programming (NLP)”	15, April, 2024	Zoom platform	01

2.2. Organize Training/ Fellowship/Workshop/Meeting

Sl. No	Title of the program	Date	Place	Number of participants
01	Industrial Training Program	20-08-2023 to 14-11-2023	EPD, AECD	10

3. Oral/Poster presentation in Symposium/Conference/Workshop(National and International)

Name of the participant	Title of oral/ poster presentation	Title of the event	Organizer	Date	Place
Dr. K.M. A. Hussain	1.Doping Effect on the Structural, Optical and Morphological Properties of undoped and Cu doped Zinc Sulfide (ZnS) Thin Films by Chemical Bath Deposition Method 2. Synthesis of ZnS Thin Film Deposited by Chemical Bath Deposition Method and its Characterizations	8 th Conference of Bangladesh Crystallographic Association	DU	24-25 November, 2023	DU
	1.Effect of Manganese Doping on the Structural and Optical Properties of Zinc Selenide Thin Films	Bangladesh. International Conference on Physics-2024	BPS	9-11 May, 2024	AECD

Name of the participant	Title of oral/ poster presentation	Title of the event	Organizer	Date	Place
T. Faruque	2. Investigate the Doping Effect on the Structural, Optical, and Morphological Properties of Undoped and Cu Doped Zinc Sulphide (ZnS) Thin Films by Chemical Bath Deposition Method				
	Single and Multiple Irradiation Effect on the Optical Properties of CdTe Thin Film Deposited By Thermal Evaporation Method	7 th International Conference on Mechanical Engineering and Renewable Energy(ICMERE-2023)	CUET	16 – 18 November 2023	CUET
	Investigate the optical properties of Zinc doped Cadmium Telluride (CdTe) thin films as nuclear detector material, deposited by thermal evaporation method	27 th National Conference of Society of Nuclear Medicine, Bangladesh held	Nuclear Medicine, Bangladesh	8 th , March 2024	Intercontinental Dhaka
	Optimizing the structural and elemental properties of chemically precipitated CdS nanoparticles through controlled annealing for advanced applications	BCSIR Congress-2023	BCSIR	8-10 March, 2024	BCSIR
	1.Doping Effect on the Structural, Optical and Morphological Properties of undoped and Cu doped Zinc Sulfide (ZnS) Thin Films by Chemical Bath Deposition Method 2. Synthesis of ZnS Thin Film Deposited by Chemical Bath Deposition Method and its Characterizations	8 th Conference of Bangladesh Crystallographic Association	DU	24-25 November, 2023	DU
	1.Effect of Manganese Doping on the Structural and Optical Properties of Zinc Selenide Thin Films 2. Investigate the Doping Effect on the Structural, Optical, and Morphological Properties of Undoped and Cu Doped Zinc Sulphide (ZnS) Thin Films by Chemical Bath Deposition Method”	Bangladesh. International Conference on Physics-2024	BPS	9-11 May,2024	AECD
	Single and Multiple Irradiation Effect on the Optical Properties of CdTe Thin Film Deposited By Thermal Evaporation Method	7 th International Conference on Mechanical Engineering and Renewable Energy(ICMERE-	CUET	16 – 18 November 2023	CUET

Name of the participant	Title of oral/ poster presentation	Title of the event	Organizer	Date	Place
		2023)			
	Investigate the optical properties of Zinc doped Cadmium Telluride (CdTe) thin films as nuclear detector material, deposited by thermal evaporation method	27 th National Conference of Society of Nuclear Medicine, Bangladesh held	Nuclear Medicine, Bangladesh	8 th , March 2024	Intercontinental Dhaka
	Optimizing the structural and elemental properties of chemically precipitated CdS nanoparticles through controlled annealing for advanced applications	BCSIR Congress-2023	BCSIR	8-10 March, 2024	BCSIR
J. Parvin	Investigate the Doping Effect on the Structural, Optical, and Morphological Properties of Undoped and Cu Doped Zinc Sulphide (ZnS) Thin Films by Chemical Bath Deposition Method”	Bangladesh. International Conference on Physics-2024	BPS	9-11 May, 2024	AECD
	Single and Multiple Irradiation Effect on the Optical Properties of CdTe Thin Film Deposited By Thermal Evaporation Method	7 th International Conference on Mechanical Engineering and Renewable Energy(ICMERE-2023)	CUET	16 – 18 November 2023	CUET
	“Investigate the optical properties of Zinc doped Cadmium Telluride (CdTe) thin films as nuclear detector material, deposited by thermal evaporation method”	27 th National Conference of Society of Nuclear Medicine, Bangladesh held	Nuclear Medicine, Bangladesh	8 th , March 2024	Intercontinental Dhaka
	Optimizing the structural and elemental properties of chemically precipitated CdS nanoparticles through controlled annealing for advanced applications	BCSIR Congress-2023	BCSIR	8-10 March, 2024	BCSIR
F. T. Z. Toma	Effect of Annealing Temperature on the properties of Iron Oxide Nanoparticles Synthesized via chemical Co-precipitation method	8 th Conference of Bangladesh Crystallographic Association	DU	24-25 November, 2023	DU
	Effect of the Annealing temperature on the properties of Iron oxide nanoparticles synthesized via chemical Co-precipitation Method	Bangladesh. International Conference on Physics-2024	BPS	9-11 May, 2024	AECD

Name of the participant	Title of oral/ poster presentation	Title of the event	Organizer	Date	Place
	Single and Multiple Irradiation Effect on the Optical Properties of CdTe Thin Film Deposited By Thermal Evaporation Method	7 th International Conference on Mechanical Engineering and Renewable Energy(ICMERE-2023)	CUET	16 – 18 November 2023	CUET
	Investigate the optical properties of Zinc doped Cadmium Telluride (CdTe) thin films as nuclear detector material, deposited by thermal evaporation method	27 th National Conference of Society of Nuclear Medicine, Bangladesh held	Nuclear Medicine, Bangladesh	8 th , March 2024	Intercontinental Dhaka
	Optimizing the structural and elemental properties of chemically precipitated CdS nanoparticles through controlled annealing for advanced applications	BCSIR Congress-2023	BCSIR	8-10 March, 2024	BCSIR

4. Collaboration work/MOU (ADP/FNCA/MEXT/FTC/IAEA/RCA/TC/S&T/CRP/In-house project, universities etc)

i) **Project work: Ministry of Science and Technology (MOST), GoB project** “Modernization of laboratories and Enhancement of Service Capacity of 3 Divisions (Chemistry Division, Health Physics Division, Experimental Physics Division) of Atomic Energy Center, Dhaka. Bangladesh Atomic Energy Commission”

Project year: 2021-24

Office order no-39.00.0000.014.14.057-21-255; Date: 13-12-2021

Grant amount: 4498.00 Lack Taka only

Project Director: Dr. Kazi Md. Amjad Hussain
Head and Chief Scientific Officer
Experimental Physics Division
Atomic Energy Centre, Dhaka

ii) Collaboration work

The Division has good collaboration with teachers and research students of

- ❖ Department of Physics and Department of Electrical and Electronic Engineering, University of Dhaka, (PhD Thesis, M.S Thesis,).
- ❖ Physics Department, Dhaka University of Engineering & Technology (DUET). (M.Phil. thesis).
- ❖ Physics Discipline, Khulna University. (B.Sc. report/ M.S. thesis).
- ❖ Department of Electrical and Electronic Engineering, University of Chittagong (M.S. thesis)
- ❖ Department of Glass and Ceramic Engineering (BUET).
- ❖ Materials Science of Semiconductor Processing Journal -as a reviewer.
- ❖ Physica B: Physics of Condensed Matter Journal as reviewer.

Every year students carry out their thesis work in the laboratories of the Division. Their works are also supervised in a close co-operation

5. Technical Report

i) “Chemical Bath Deposition (CBD): Exploring processes, Applications and innovations in Thin Films and Nanotechnology”; Author: Fatema Tuz Zohora Toma, Co-authors: Tania Faruque, Syed Ahmed, Supervision: Dr. Kazi Md. Amjad Hussain; AECD/EPD/16; May, 2024, Published by Atomic Energy Centre, Dhaka.

6. Repair & Maintenance, Renovation works, etc:

Chemical Bath Deposition (CBD) System

We are facing difficulties during functioning and depositions of the system due to the following reasons: The Chemical Bath Deposition system dependent on heat control and magnetic stirrer control switch. In this system heat control panel does not work properly which is currently unable to work that's why we could not deposit thin film properly and the sample preparation is not possible in this situation for the last few months, now the system is under repairing position.

Health Physics Division, AECD

Objective

The objective of Health Physics division is to protect life, property and environment from undue radiation hazard through: (a) Population exposure control (b) Occupational exposure control and (c) Radiation protection. Radiation and radioactivity in environmental samples & imported/exportable foods (except Chittagong Port) and individual Monitoring Services (IMS) of occupational workers are being monitored as per requirement of the NSRC rules 1997 and BAER Act-2012. This division is one of the most important Technical Support Organization (TSO) of Rooppur Nuclear Power Plant (RNPP). Health Physics division has been provided nuclear and radiological emergency services in case of any incident or accident.

1. Research and Development Work

1.1 Evaluation of Radioactivity and Associated Hazards in Soil and Water near Bangladesh's First Nuclear Power Plant before Commissioning

S. Yeasmin, M.M. Mahfuz Siraz, Z. Hossain, A. Joydhar and S.K. Das*

This study comprehensively examines natural and human-made radioactivity in soil and surface water samples near the under-construction Rooppur Nuclear Power Plant (RNPP) in Bangladesh. The study analyzed activity concentrations of ^{226}Ra , ^{232}Th , and ^{40}K in fifty soil and fifty water samples, with results ranging from 18–38, 18–51, and 310–560 Bqkg^{-1} for soil, and 2.1–6.1, 2.1–5.5, and 67–115 BqL^{-1} for water, respectively. While outdoor absorbed dose rate, outdoor effective dose, and gamma representative level index values in some soil samples exceeded global averages, other radiological parameters such as radium equivalent activity, annual effective dose, external and internal hazard indices, and lifetime carcinogenic risk for both soil and water samples consistently remained below safety thresholds set by international standards. These findings suggest that the soil and water samples near the RNPP do not pose significant radiological hazards to nearby populations or ecosystems.

*Department of Physics, Jagannath University, Dhaka.

1.2 Assessing Radioactivity and Hazards: Analysis of Soil, Water, and Coal Samples near a Coal-fired Thermal Power Plant and their Implications for Human Health and the Environment

S. Yeasmin, M.M. Mahfuz Siraz, Z. Hossain, A. Joydhar and, S.K. Das*

A detailed study was conducted within a 3 km radius surrounding the site of Barapukuria Coal Mine Company Limited (BCMCL), Bangladesh's premier operational coal-fired thermal power plant. 50 soil samples, 50 water samples, and 21 coal samples were collected from a variety of locations inside and beyond the BCMCL boundaries, and these samples were then analysed for radioactivity using a high-purity germanium detector. The range of activity concentrations of ^{226}Ra , ^{232}Th , and ^{40}K in the studied soil, water and coal samples were 24–47, 30–76, and 340–570 Bqkg^{-1} ; 1.6–2.9, 1.1–3.8, and 53–92 Bqkg^{-1} ; 19–57, 20–97, and 78–170 Bqkg^{-1} respectively. The majority of hazard indices, including absorbed dose rate, gamma index, effective dose, and excess lifetime cancer risk, associated with soil samples were higher than the world average. This indicates that long-term exposure to terrestrial ionising radiation is unsafe for coal miners and the local community.

*Department of Physics, Jagannath University, Dhaka.

1.3 Measurement of Environmental Gamma Radiation Dose Rates near the Construction Site of the RNPP, AERE, and BCMCL Area

S Yeasmin, N. Sultana, M.M. Mahfuz Siraz, Z. Hossain, A. Joydhar and S.K. Das*

Gamma radiation dose rates have been measured at 300 monitoring points in the vicinity of the construction of RNPP site, CRR and BCMCL in Bangladesh. A digital survey meter was used for real-time gamma dose assessment at each monitoring point, and a GARMIN eTrex personal navigator was used to record Global Positioning System (GPS) coordinates. The mean gamma dose rates recorded in real-time were $0.100 \pm 0.033 \mu\text{Svh}^{-1}$ for RNPP, $0.235 \pm 0.007 \mu\text{Svh}^{-1}$ for indoor and $0.173 \pm 0.005 \mu\text{Svh}^{-1}$ for outdoor of the CRR in AERE, and $0.133 \pm 0.014 \mu\text{Svh}^{-1}$ for BCMCL. Corresponding average annual effective doses for these locations were $0.176 \pm 0.059 \text{ mSvy}^{-1}$, $1.649 \pm 0.049 \text{ mSvy}^{-1}$, $0.303 \pm 0.008 \text{ mSvy}^{-1}$, and $0.233 \pm 0.025 \text{ mSvy}^{-1}$, respectively. The objective of this study is to detect any potential release of natural or artificial radionuclides from nuclear power plant, research reactor and coal fired thermal power plant facilities.

*Department of Physics, Jagannath University, Dhaka.

1.4 Worldwide Proficiency Test Exercise on the Determination of Anthropogenic and Natural Radionuclides in Water, Bauxite, Sediment and Simulated Contaminated Surface samples

S. Yeasmin, M.M.M. Siraz, S. Pervin, N. Sultana, M. Begum and J. Ferdous

As a part of environmental radioactivity monitoring, Health Physics Division of Atomic energy centre, Dhaka is participating IAEA Worldwide Proficiency Test Exercise -2024. IAEA provided 8 samples which contains water, bauxite, sediment and simulated contaminated surface samples from Seibersdorf, Austria. The raw water was gravimetrically spiked with a known amount of a standard solution and each bottle contains approximately 500 g of water. The identification of gamma emitting radionuclides is one of the tasks of this proficiency test. Approximately 100 g of sediment and 200 g of bauxite have been provided for gamma spectrometry measurement. The Simulated contaminated surface samples also have been provided for the analysis of Cs-134 & Sr-90 activity level. Further work is in progress.

1.5 Inter-comparison Exercise on Individual Monitoring for External Exposure -2024 under the Regional TC Project RAS/9/093

S. Yeasmin, S. Hossain, Z. Hossain, and J. Ferdous

To harmonize of monitoring practices, exchange of knowledge on external dosimetry and achieve a common understanding among authorized or approved dosimetry service providers that operate under a quality management system. As the part of Occupational Radiation Protection, Health Physics Division of Atomic Energy Centre, Dhaka is participating IAEA Regional Inter-comparison Exercise on Individual Monitoring for External Exposure- 2024. The IC exercise is one of the outputs of RAS/9/093 Regional Project for the harmonization of monitoring practices, exchange of knowledge on external dosimetry and achieve a common understanding among authorized or approved dosimetry service providers that operate under a quality management system. For this purpose, total of 42 dosimeters are send to the Secondary Standard Dosimetry Laboratory (SSDL) of the China Institute for Radiation Protection (CIRP) for irradiations. Further work is in progress.

1.6 Survey of Background Radiation Levels throughout Bangladesh

S. Yeasmin, J. Ferdous, M. Begum, M.M.M. Siraz, S. Pervin, S. Hossain, N. Hassan, N. Sultana, Z. Hossain, and A. Joydhar

During this reporting period, measurement of background radiation level has been carried out regularly in and around Dhaka city on monthly basis as a part of this work. In this study, Gamma Scout (w/Alert, Digital Survey meter) was used with Global Positioning System (GPS) for pointing the location. The average background radiation level was found from (0.15 to 0.30) μSvh^{-1} . It is observed that there is no change in background radiation level from the data of previous years.

1.7 Workplace Monitoring of Different Radiation Facilities of Atomic Energy Centre Dhaka

S. Yeasmin, J. Ferdous, M. Begum, M.M.M. Siraz, S. Pervin, S. Hossain, N. Hassan, N. Sultana, Z. Hossain, and A. Joydhar

Five divisions of AECD, viz. Non-Destructive Testing (NDT), Accelerator Facilities Division (AFD), Material Science Division (MSD), Chemistry Division and Health Physics Division (HPD) of AECD have been using radioisotopes and radiation producing equipment's for research & development works. Radiation monitoring has been done on monthly basis in and around the above-mentioned divisions by using Gamma Scout (w/Alert, Digital Survey meter). The radiation levels in front of isotope storeroom (corridor) of HPD, Source room (corridor) of HPD, NDT Source storeroom and in front of door of NDT source room were found (0.51 - 2.25) $\mu\text{Svh-1}$, (0.29 - 0.47) $\mu\text{Svh-1}$, (0.55 - 4.41) $\mu\text{Svh-1}$ and (0.27-0.45) $\mu\text{Svh-1}$ respectively. The control panel of AFD, XRD room of MSD and EDXRF room of Chemistry division were found around background level.

1.8 Measurement of Radioactivity in Rain Water

S. Yeasmin, J. Ferdous, M. Begum, M.M.M. Siraz, S. Pervin, S. Hossain, N. Hassan, N. Sultana, Z. Hossain, and A. Joydhar

During the reporting period, fifteen rain water samples were collected from AECD campus Dhaka and Tongi. The activity concentration of natural radionuclides ^{238}U , ^{232}Th , and ^{40}K were determined by Gamma Spectrometry System consists of High Purity Germanium (HPGe) detector. The radioactivity range of ^{238}U series, ^{232}Th series and ^{40}K was within the acceptable limit. Artificial radionuclide was not found.

1.9 Radioactivity Concentration of Different Food Samples Imported from SAARC and other Countries

S. Yeasmin, J. Ferdous, M. Begum, M.M.M. Siraz, S. Pervin, S. Hossain, N. Hassan, N. Sultana, Z. Hossain, and A. Joydhar

As a part of radioactivity monitoring surveillance program, total 30 (Thirty) imported food samples were collected from different local markets in Mirpur, Dhaka. Different Food samples such as Anchor Beans, Dabli, Ginger, Garlic, Rice, Red Wheat, White Wheat, Lentils, Chhola, Palm Oil and Soybean oil were imported from different countries such as Australia, China, India, Pakistan, Maldives, Malaysia and Nepal. The samples were processed following the standard procedures provided by IAEA and analyzed for gamma emitting radionuclides. The radioactivity range of ^{238}U series, ^{232}Th series and ^{40}K was within the acceptable limit. Artificial radionuclide was not observed. To monitor the level of radioactivity in different food samples imported from SAARC and other countries as a part of radioactivity monitoring surveillance program.

1.10 Study on Outdoor Gamma Radiation of DMCH by In-Situ Method

M.S.Rahman, S. Yeasmin, M. Begum, M.M.M. Siraz, S. Pervin, M. Hassan, S. Hossain, N. Hassan, N. Sultana and Z. Hossain

In-Situ Environmental gamma-ray dose rate was measured at 32 locations of DMCH campus using real-time environmental radiation measuring device (GAMMA-SCOUT GmbH & Co. KG). This device meets all European CE standards as well as the American "FCC 15 standard". All the locations were marked out using global positioning system (GPS). The dose rate varied from 0.080-0.270 $\mu\text{Sv/h}$ at outdoor locations around the DMCH campus. The annual effective dose of the population due to the environmental gamma radiation was also calculated and it was varied from 0.087-0.438 mSv.

1.11 Study on Outdoor Gamma Radiation of BSMMU by In-Situ Method

M. S. Rahman, S. Yeasmin, M. Begum, M.M.M. Siraz, S. Pervin, M. Hassan, S. Hossain, N. Hassan, N. Sultana, Z. Hossain

In-Situ Environmental gamma-ray dose rate was measured at 32 locations of BSMMU campus using real-time environmental radiation measuring device (GAMMA-SCOUT GmbH & Co. KG). This device meets all European CE standards as well as the American "FCC 15 standard". All the locations were marked out using global positioning system (GPS). The dose rate varied from 0.070-0.290 $\mu\text{Sv/h}$ at outdoor. The annual

effective dose of the population due to the environmental gamma radiation was also calculated and it was varied from 0.076-0.472 mSv at outdoor.

1.12 Study on Outdoor Radiation around Five Large Hospitals Campuses by In-Situ Method

M. S. Rahman, S. Yeasmin, M. Begum, M.M.M. Siraz, S. Pervin, M. Hassan, S. Hossain, N. Hassan, N. Sultana, Z. Hossain

Nuclear medicine workers usually handle radioactive sources during preparation and administering. So, there is a possibility to receive higher doses during their daily work. Therefore, it is required to measure real-time gamma radiation dose rate in nuclear medicine departments in order to ensure safe working environment of workers. In-Situ indoor radiation was measured at 160 locations of five large hospitals campuses of Dhaka city using real-time gamma radiation measuring device (GAMMA-SCOUT GmbH & Co. KG). This device meets all European CE standards as well as the American “FCC 15 standard”. All the locations were marked out using global positioning system (GPS). The radiation dose rate around five large hospitals campuses varied from 0.124- 0.316, 0.12-0.26, 0.11-0.235, 0.127-0.182, 0.131-0.340 $\mu\text{Sv/h}$.

1.13 Continuous Radiation Monitoring at Indoor Places of AECD Campus using Thermoluminescent Dosimeter

M. S. Rahman, S. Yeasmin, M. Begum, M.M.M. Siraz, S. Pervin, M. Hassan, S. Hossain, N. Hassan, N. Sultana, Z. Hossain

Indoor radiation was measured at 20 locations of AECD campus using thermoluminescent dosimeters. The measurement was performed from October 2023-May 2024. The indoor radiation dose rate varied from 285-420 $\mu\text{Sv/month}$ with an average of 335 $\mu\text{Sv/month}$. The annual effective dose of the population due to the indoor gamma radiation was also calculated and it was varied from 1.113 – 2.695 mSv.

1.14 Study on Outdoor Radiation of Khulna Medical College Hospital Campus by In-Situ Method

M. S. Rahman, S. Yeasmin, M. Begum, M.M.M. Siraz, S. Pervin, M. Hassan, S. Hossain, N. Hassan, N. Sultana, Z. Hossain

In-Situ outdoor radiation was measured at 32 locations of Khulna Medical College Hospital Campus using real-time gamma radiation measuring device (GAMMA-SCOUT GmbH & Co. KG). This device meets all European CE standards as well as the American “FCC 15 standard”. All the locations were marked out using global positioning system (GPS). The outdoor radiation dose rate varied from 0.097- 0.51 $\mu\text{Sv/h}$ with an average of 0.161 $\mu\text{Sv/h}$. The annual effective dose of the population due to the outdoor gamma radiation was also calculated and it was varied from 0.219 – 0.372 mSv. Nuclear medicine workers usually handle radioactive sources during preparation and administering. So, there is a possibility to receive higher doses during their daily work. Therefore, it is required to measure real-time gamma radiation dose rate in nuclear medicine departments in order to ensure safe working environment of workers.

1.15 Study on Outdoor Radiation of Asgar Ali & IBN Sina Hospitals Campuses by In-Situ Method

M. S. Rahman, S. Yeasmin, M. Begum, M.M.M. Siraz, S. Pervin, M. Hassan, S. Hossain, N. Hassan, N. Sultana, Z. Hossain

In-Situ outdoor radiation was measured at 64 locations of Asgar Ali & Ibn Sina Hospitals Campuses using real-time gamma radiation measuring device (GAMMA-SCOUT GmbH & Co. KG). This device meets all European CE standards as well as the American “FCC 15 standard”. All the locations were marked out using global positioning system (GPS). The outdoor radiation dose rates of Asgar Ali & Ibn Sina Hospitals campuses were varied from 0.050- 0.630 & 0.19-0.361 $\mu\text{Sv/h}$ respectively. The annual effective dose of the population due to the outdoor gamma radiation was also calculated and it was varied from 0.080 – 1.160 & 0.163-0.652 mSv respectively.

1.16 Study on Outdoor Radiation in Chittagong Medical College Hospital Campus by In-Situ Method

M. S. Rahman, S. Yeasmin, M. Begum, M.M.M. Siraz, S. Pervin, M. Hassan, S. Hossain, N. Hassan, N. Sultana, Z. Hossain

AERE campus has research reactor, radioactive waste management facility, gamma irradiator etc. So, there is a possibility to receive higher doses during their daily work. Therefore, it is required to measure real-time gamma radiation dose rate in AERE campus in order to ensure safe working environment of workers. In-Situ outdoor radiation was measured at 32 locations of CMCH campus using real-time gamma radiation measuring device (GAMMA-SCOUT GmbH & Co. KG). This device meets all European CE standards as well as the American “FCC 15 standard”. All the locations were marked out using global positioning system (GPS). The outdoor radiation dose rate varied from 0.129- 0.198 $\mu\text{Sv/h}$ with an average of 0.149 $\mu\text{Sv/h}$. The annual effective dose of the population due to the outdoor gamma radiation was also calculated and it was varied from 0.219– 0.456 mSv.

1.17 Thermoluminescent Characterization of Laboratory Synthesized Materials for Ionizing Radiation Dosimetry

A.K.M.Mizanur Rahman, Shah Azharul Islam*, Md. Raghieb Rahat*, Homaira Afia Mimi*, Md. Kamruzzaman*, Z. Hossain, S. Hossain, S. Yeasmin

A range of TL materials are synthesized in this research, highlighting their TL characteristics and dosimetric potential. The synthesis process incorporates advanced synthesis methodologies to ensure enhanced purity and cost-effectiveness, while maximizing TL properties of the aforementioned materials. TL characteristics are evaluated through TL glow curve analysis, linearity, sensitivity, threshold dose, effective atomic mass computation, and kinetic parameters such as geometric factor, order of kinetics, activation energy, and frequency factor. In this study, LiCaPO_4 , LiZnBO_3 , LiMgBO_3 , and LiF doped with Mn, Mn-Cu, Ti, and Ti-Cu are synthesized and studied for TL. LiCaPO_4 , a ceramic material, exhibits remarkable thermoluminescence (TL) properties post LINAC irradiation, characterized by consistent peaks at 200°C and 240°C for both photon and electron energies with 3% fading in 28 days. LiZnBO_3 , a glass-like material, exhibits sub-linearity and heightened sensitivity, with matching peaks at 160°C and 240°C. The studied TL properties suggest the suitability in radiation dosimetry and associated field.

* Department of Physics, Begum Rokeya University, Rangpur.

1.18 Development of Novel Radiation Sensors to Measure and Detect Ionizing Radiation

A.K.M.Mizanur Rahman, Shah Azharul Islam*, Md. Raghieb Rahat*, Homaira Afia Mimi*, Md. Kamruzzaman*, Z. Hossain, S. Hossain, S. Yeasmin

Dosimetric properties of the different types tailor-made sensor materials were investigated including dose responses over the dose range from low to high doses, sensitivity, reproducibility, signal fading, percent depth dose etc. Kinetic parameters including geometric factor, order of kinetics, activation energy, frequency factor etc. and material characterization was also performed. For 6 MV photon energy, the TL data demonstrated steady maxima at about 240°C with ~3% fading after 30 days. The measurement was compared with standard values. The synthesized materials mentioned above have been examined for their luminescent properties, which suggest that they could be useful for dosimetry applications involving both individuals and environments.

* Department of Physics, Begum Rokeya University, Rangpur.

1.19 Synthesis and Characterization of Ce-Doped and Undoped LiZnBO_3 (LZB) Phosphor for Dosimetry Applications

A.K.M.Mizanur Rahman, S. Hossain, M. Hassan, Z. Hossain, and S. Yeasmin

The pristine LZB was synthesized by the solid-state reaction (SSR) technique. The structural properties of the synthesized composites were investigated by X-ray diffraction (XRD) and Fourier Transform Infrared (FT-IR) measurements. The magnetic hysteresis (M-H) loop was characterized using Vibrating Sample Magnetometry (VSM) to distinguish its magnetic characteristics and alterations. A clinical Linear Accelerator (LINAC) was used to irradiate the samples with both electron (6 MeV) and X-ray photon beam (6 MV), with a dose range of 0.5 Gy to 8 Gy for both beams. The experiment was designed to study low to medium-dose thermoluminescence (TL) response for LZB. The irradiated samples were readout for TL signal using a

Harshaw-3500 TL reader. This study explores the dosimetric potentials of pristine LZB phosphor for medical application.

1.20 Study of Structural, Thermoluminescent (TL) and Kinetic Properties of LiF by Mn and Cu Doping for Dosimetry Applications

A.K.M.Mizanur Rahman, S. Hossain, M. Hassan, Z. Hossain, and S. Yeasmin

The LiF phosphor was synthesized and doped with various percentages of Mn and Cu successfully. A clinical Linear Accelerator (LINAC) was used to irradiate the samples with X-ray photon beam (6 MV), with a dose range of 0.5 Gy to 10 Gy. The irradiated samples were readout for TL signal using a Harshaw-3500 TL reader.

1.21 Synthesis, Structural Features and Thermoluminescence (TL) Traits of LiF:Ti and LiF:Ti, Cu for Radiation Dosimetry Applications

A.K.M.Mizanur Rahman, S. Hossain, M. Hassan, Z. Hossain, and S. Yeasmin

The LiF phosphor was synthesized and doped with various percentages of Ti and combination of Ti and Cu successfully. A clinical Linear Accelerator (LINAC) was used to irradiate the samples with X-ray photon beam (6 MV), with a dose range of 0.5 Gy to 10 Gy. The irradiated samples were readout for TL signal using a Harshaw-3500 TL reader.

1.22 Radiation Risk Assessment on Public and Occupational Workers of Midford Hospital Campus

M. Begum, M.S. Rahman, M.M.M. Siraz, S. Pervin, M. Hasan, S. Hossain, N. Hassan, N. Sultana, Z. Hossain, and S. Yeasmin

In this study, to estimate the radiation risk on public and occupational workers, external dose rate in and around Midford Hospital campus have been assessed. Ionizing radiation is used widely in the hospitals for therapeutic and diagnostic purpose, so radiation monitoring is very important for radiation hazard detection in the environment. The excess life-time cancer risk (ELCR) assessment on public and occupational workers due to outdoor annual effective radiation dose is required for healthy life. The radiation monitoring has been performed using digital portable radiation monitoring device (DPRMD), which meets all European CE standards and the American “FCC 15 standard”. Data analysis is in progress

1.23 Radiological Risks Assessment in the Industrial Area beside the Branch of Bangshai River, Bangladesh

M. Begum, M.M.M. Siraz and S. Yeasmin

Total 15 soil and sediment samples from the industrial area beside the branch of Bangshai river have been collected for radiological risks assessment. A high-resolution HPGe detector (p type, Model no. GCD-30185) has been used in this study where, the energy peak at 1.33 MeV corresponding to ^{60}Co exhibited an energy resolution of 1.67 keV at full-width half-maximum (FWHM) with a relative efficiency of 30%. As the part of environmental radioactivity monitoring program, environmental samples have been analyzed using gamma spectrometry system for radiological risks assessment. Total 7 radiological hazard indices: radium equivalent activity, gamma representative level index, external absorbed dose rate, annual effective dose rate, external hazard index, internal hazard index and excess lifetime cancer risk (ELCR) will be assessed for the mentioned samples, where data analysis are in progress.

1.24 Radiological Hazard Indices Assessment in Soil and Sediment Samples from Shahbazpur and Saldanadi Gas Field Environment of Bangladesh

M. Begum, R. Khan, M.M.M. Siraz, K. Naher, S. M. M. Al-Mamun* and S. M. Hossain

Total fifteen (15) soil and sediment samples have been analyzed by using High Purity Germanium (HPGe) gamma detector for assessment of radiological hazard of Shahbazpur and Saldanadi gas field environment of Bangladesh. The average activity concentrations of ^{226}Ra , ^{232}Th and ^{40}K in soil and sediment samples were found $37.0 \pm 10.1 \text{ Bqkg}^{-1}$, $71.9 \pm 12.1 \text{ Bqkg}^{-1}$ and $838 \pm 185 \text{ Bqkg}^{-1}$ respectively. The calculated average values were higher than corresponding world average values. Absorbed dose rate were found to be varied from 65 nGyh^{-1} to 126 nGyh^{-1} with an average value of 96.92 nGyh^{-1} , which is significantly higher than

corresponding recommended value of 55 nGy^{-1} . Values of Excess Lifetime Cancer Risk (ELCR) and γ -representative level index (I_γ) were also higher than corresponding recommended values.

*Department of Electrical and Electronic Engineering, University of Dhaka, Dhaka.

1.26 Radioactivity Concentration Assessment of Gas Reservoir Core Samples of Shahbazpur and Saldanadi Gas Field, Bangladesh

M. Begum, R. Khan, K. Naher, S. M. Hossain and S. M. M. Al-Mamun*

In this study, total fourteen (14) gas-reservoir well core samples have been analyzed in this study by using High Purity Germanium (HPGe) gamma detector for assessment of radioactivity concentration of Shahbazpur and Saldanadi gas field of Bangladesh. Two types of software were used for gamma spectra acquisition: Genie 2000 (CANBERRA) and MAESTRO-32 (ORTEC). The Hypermet PC Version 5.12 was used for gamma peak analysis. The average activity concentrations of ^{226}Ra , ^{232}Th and ^{40}K in gas-reservoir well core samples were found $57.8 \pm 15.3 \text{ Bqkg}^{-1}$, $92.7 \pm 19.5 \text{ Bqkg}^{-1}$ and $2117 \pm 618 \text{ Bqkg}^{-1}$ respectively. The calculated average values are significantly higher than corresponding world average values of 35 Bqkg^{-1} , 30 Bqkg^{-1} and 400 Bqkg^{-1} respectively.

*Department of Electrical and Electronic Engineering, University of Dhaka, Dhaka.

1.27 NORM Assessment of Gas Reservoir Core Samples of Jalalabad and Sitakundo Gas Fields, Bangladesh

M. Begum, R. Khan, K. Naher, S. M. Hossain and S. M. M. Al-Mamun*

Gas-reservoir well core samples have been analyzed in this work using High Purity Germanium (HPGe) detector for assessment of NORM concentration of Jalalabad and Sitakundo gas fields of Bangladesh. Genie 2000 (CANBERRA) and MAESTRO-32 (ORTEC), two types of software have been used for gamma spectra acquisition. The average radioactivity concentrations of NORM i.e. ^{226}Ra , ^{232}Th and ^{40}K in gas-reservoir well core samples of Jalalabad gas field have been found $38.3 \pm 3.6 \text{ Bqkg}^{-1}$, $50.7 \pm 9.2 \text{ Bqkg}^{-1}$ and $1727 \pm 818 \text{ Bqkg}^{-1}$ respectively. The average radioactivity concentrations of ^{226}Ra , ^{232}Th and ^{40}K in core samples of Sitakundo gas field have been found $49.4 \pm 10.6 \text{ Bqkg}^{-1}$, $82.7 \pm 10.0 \text{ Bqkg}^{-1}$ and $1890 \pm 649 \text{ Bqkg}^{-1}$ respectively. The calculated average values are significantly higher than corresponding world average values of 35 Bqkg^{-1} , 30 Bqkg^{-1} and 400 Bqkg^{-1} respectively.

*Department of Electrical and Electronic Engineering, University of Dhaka, Dhaka.

1.28 Radiation Hazard Assessment for Core Samples of Rashidpur and Koilastila Gas Fields of Bangladesh

M. Begum, R. Khan, K. Naher, S. M. Hossain and S. M. M. Al-Mamun*

For radiological hazard assessment of Rashidpur and Koilastila gas fields of Bangladesh, gas-reservoir well core samples have been analyzed by gamma spectrometry method, where the Hypermet PC Version 5.12 has been used for gamma peak analysis. Average radioactivity concentrations (Bq.kg^{-1}) in gas-well core samples (^{226}Ra : 36.7 ± 8.8 ; ^{232}Th : 54.9 ± 9.7 ; ^{40}K : 1146 ± 572) are higher than corresponding world average values of 35 Bqkg^{-1} , 30 Bqkg^{-1} and 400 Bqkg^{-1} respectively. Evaluation of radiological hazard indices of gas well core samples of two gas fields suggests that three of the radiological hazard indices (absorbed dose rate, Excess Lifetime Cancer Risk (ELCR) and γ -representative level index) are higher than corresponding recommended values.

*Department of Electrical and Electronic Engineering, University of Dhaka, Dhaka.

1.29 Neutron Activation Analysis for Elemental Abundance Assessment of the Core Samples of Fenchuganj Gas Field

M. Begum, R. Khan, K. Naher, S. M. Hossain and S. M. M. Al-Mamun*

A total of 29 major, trace and REE elemental (Na, Al, K, Ca, Sc, Ti, V, Cr, Mn, Fe, Co, Zn, Ga, As, Rb, Sb, Cs, Ba, La, Ce, Sm, Eu, Dy, Yb, Hf, Ta, W, Th and U) abundances in eight gas-well core samples from gas

reservoir well no.-2 of Fenchuganj gas field of Bangladesh were determined by using Neutron Activation Analysis (NAA). To study the mobilization due to weathering and depositional environmental condition at different stages of elemental abundances with the crustal origin, Enrichment Factor (EF) for each elemental abundances in different gas-well core samples have been measured. The EF values of the As ranges from 0.55 to 2.72 and Cs ranges from 0.77 to 2.06 i.e. the enrichment of As and Cs are minor in core samples of this gas field. Also rare earth lanthanide metals like La, Ce, Sm, Eu and Dy show enrichment. In this study, As and Cs are on the way to moderate geo-accumulation, Igeo in most of the core samples of Fenchuganj gas field. So, there is a possibility of surrounding environment to be polluted more by As and Cs through gas production process.

*Department of Electrical and Electronic Engineering, University of Dhaka, Dhaka.

1.30 Elemental Characterization of the Reservoir Core Samples of Saldanadi Gas Field

M. Begum, R. Khan, K. Naher, S. M. M. Al-Mamun* and S. M. Hossain*

Geochemical analysis for heavy metals and mineralogy can predict where petroleum, metals, water, and commercially valuable minerals can be located. Neutron Activation Analysis (NAA) is a nuclear analytical technique to determine the concentration of elements based on the activation by neutrons so that the radioactivated samples emit gamma-rays. Due to the versatile applicability and high sensitivity, TRIGA Mark II research reactor and HPGe gamma detector based NAA was used to determine the major, minor and trace elemental composition of the core sample of Saldanadi Gas Field. In this study, relative standardization method of NAA was used by employing multi-element standards and certified reference materials. To apply relative standardization approach, we used two reference materials (IAEA-Soil-7 and IAEA-SL-1) and one certified reference materials (NIST 1633b: Coal Fly Ash). In this study, the elemental characterization of the core samples were performed in terms of Na, Al, K, Sc, Ti, V, Cr, Mn, Fe, Co, Zn, As, Rb, Cs, Ba, La, Ce, Sm, Eu, Dy, Yb, Hf, Ta, Th and U abundances.

*Department of Electrical and Electronic Engineering, University of Dhaka, Dhaka.

1.31 Radiation Hazard Assessment in Soil and Sediment Samples from Gas Field Environment of Fenchuganj, Bangladesh

M. Begum, R. Khan, K. Naher, S. M. Hossain and S. M. M. Al-Mamun*

For assessment of radiological hazard in Fenchuganj gas field environment of Bangladesh, total thirteen (13) soils, sediment, and gas-reservoir well core samples have been analyzed by using High Purity Germanium (HPGe) gamma detector, where the Hypermet PC Version 5.12 has been used for gamma peak analysis. Average radioactivity concentrations (Bq.kg^{-1}) in gas-well core samples (^{226}Ra : 47.5 ± 11.6 ; ^{232}Th : 74.9 ± 14.7 ; ^{40}K : 1805 ± 387) are significantly higher than surface soil and sediment samples (^{226}Ra : 24.4 ± 6.0 ; ^{232}Th : 49.1 ± 23.8 ; ^{40}K : 360 ± 135). Evaluation of radiological hazard indices of gas well core samples suggests considerable risks. Values of three of the radiological hazard indices for surface soil and sediment samples of Fenchuganj gas field are around the corresponding recommended values.

*Department of Electrical and Electronic Engineering, University of Dhaka, Dhaka.

1.32 Radiological Contamination Investigation of Soils Collected from Major Ship Breaking Yards in Sitakunda, Chattogram, Bangladesh

M.M. Mahfuz Siraz, Araf Mahmud*, Khondokar Nazmus Sakib* and Selina Yeasmin

The second largest ship-breaking installations in the world are concentrated in the Sitakunda coastal line along the Bay of Bengal, Bangladesh. Thirty soil samples were collected from the various locations of Sitakunda, Chattogram to assess radiological risk due to primordial radionuclides in the coastal zone. Thirty soil samples were collected from the various locations of Sitakunda, Chattogram to assess radiological risk due to primordial radionuclides in the coastal zone. The activity concentrations of primordial radionuclides ^{226}Ra , ^{232}Th and ^{40}K was found to be in the range of $(13 \pm 1 \text{ to } 37 \pm 3) \text{ Bq.kg}^{-1}$ with an average activity of $(22 \pm 1) \text{ Bq.kg}^{-1}$ $(21 \pm 2 \text{ to } 47 \pm 4) \text{ Bq.kg}^{-1}$ with an average activity of $(35 \pm 3) \text{ Bq.kg}^{-1}$ and $(220 \pm 19 \text{ to } 590 \pm 55) \text{ Bq.kg}^{-1}$ with an average activity of $(438 \pm 41) \text{ Bq.kg}^{-1}$ respectively. Some of the ^{232}Th and ^{40}K values exceeded the corresponding world average values. No ^{137}Cs activity concentration was identified in any sample at the

ship-breaking area. Some of radiological hazard parameter values in ship-breaking areas, like outdoor dose rate, hazard index, external effective dose, annual effective dose, gamma level index, and ELCR, were higher than the worldwide allowable limit.

* Department of Physics, Mawlana Bhashani Science and Technology University, Tangail.

1.33 Assessment of Elevated Level of Natural Radioactivity of Sand Samples Collected from Various Sea-Beaches in Cox's Bazar, Bangladesh

M.M. Mahfuz Siraz, Jannatul Mawa Trishna*, Khondokar Nazmus Sakib* and Selina Yeasmin

Cox's Bazar Sea Beach is the longest sandy sea beach in the world. In this current study, the activity concentrations of natural radionuclides ^{226}Ra , ^{232}Th , & ^{40}K in forty sand samples gathered from multiple sea beaches in Cox's Bazar are measured by using a High Purity Germanium (HPGe) detector. The activity concentrations of ^{226}Ra , ^{232}Th and ^{40}K in the sand samples have been found to be varied from 6 ± 1 to $175 \pm 17 \text{ Bqkg}^{-1}$, $8 \pm 1 \text{ Bqkg}^{-1}$ to $320 \pm 30 \text{ Bqkg}^{-1}$ and $250 \pm 21 \text{ Bqkg}^{-1}$ to $420 \pm 37 \text{ Bqkg}^{-1}$ respectively. A particular sand sample shows the higher values of activity concentration, absorbed dose rates, annual effective dose, external & internal hazard index, and gamma level index, which indicate the hazardous for the human being. No artificial radionuclides were found in the collected sample.

* Department of Physics, Mawlana Bhashani Science and Technology University, Tangail.

1.34 Radionuclide Transfer in Tea Cultivation: Assessing Radiological Risks in the largest and first established tea garden in Bangladesh

M.M. Mahfuz Siraz, Md. Hossain Kamal*, Zulfiqar Hasan Khan*, Z. Hossain and S. Yeasmin

A study was conducted utilizing high purity germanium (HPGe) γ -ray spectrometry to measure the concentrations of ^{226}Ra , ^{232}Th , ^{40}K , and ^{137}Cs radionuclides in soil and tea leaves collected from several major tea gardens situated in Sylhet, Bangladesh. Although nearly all soil samples showed the presence of ^{137}Cs (with a maximum activity of $6.5 \pm 1.31 \text{ Bqkg}^{-1}$), none of the analyzed tea leaf samples exhibited its presence. The range of transfer factors for ^{226}Ra , ^{232}Th and ^{40}K from soil to tea leaves was calculated to be (0.39-0.54), (0.25-0.46) and (1.39-3.03), respectively. The examination of hazard parameters, including the estimated committed effective dose and the excess lifetime cancer risk associated with tea consumption, reveals values that are comparatively lower than the recommended limits. Consequently, the radiation exposure from tea consumption does not present a significant radiological health concern for the general population.

* Department of Physics, University of Dhaka, Dhaka.

1.35 Assessment of Radioactivity & Associated Transfer Factors from Soil to Rice in the Samples Collected from Jamalpur, Bangladesh

M.M. Mahfuz Siraz, Md. Shamim Yeasir Saion*, Zulfiqar Hasan Khan* and S. Yeasmin

Twelve rice samples and their corresponding soil samples were collected from different areas of Jamalpur and the activity concentrations of radionuclides were determined by gamma-ray spectrometry using a high-purity germanium (HPGe) detector. The average activity levels of the natural radionuclides Ra-226, Th-232, and K-40 in soil samples were determined as $31.5 \pm 0.3 \text{ Bqkg}^{-1}$, $50.3 \pm 0.21 \text{ Bqkg}^{-1}$, and $538.3 \pm 1.59 \text{ Bqkg}^{-1}$, respectively. The average activity levels of the natural radionuclides Ra-226, Th-232, and K-40 in rice samples were determined as $2.65 \pm 0.3 \text{ Bqkg}^{-1}$, $2.81 \pm 0.21 \text{ Bqkg}^{-1}$, and $110.33 \pm 1.59 \text{ Bq/kg}$, respectively.

* Department of Physics, University of Dhaka, Dhaka.

1.36 Assessment of Naturally Occurring Radioactivity and Radiological Evaluation of Decorative Construction Materials in Bangladesh

M.M. Mahfuz Siraz, Md. Shihab Uddin Shuvo*, Zulfiqar Hasan Khan* and S. Yeasmin

The current study utilizes gamma-ray spectrometry using an HPGe detector to measure the level of natural radioactivity in typical construction materials (decorative or ornamental) used in Bangladeshi homes. For 20 samples of interest consisting of granite, marble, tile, and paint samples, the activity concentration level of

^{226}Ra , ^{232}Th , and ^{40}K varied between $4\pm 1\text{ Bqkg}^{-1}$ to $78\pm 6\text{ Bqkg}^{-1}$, $7\pm 1\text{ Bqkg}^{-1}$ to $66\pm 5\text{ Bqkg}^{-1}$, and $50\pm 5\text{ Bqkg}^{-1}$ to $690\pm 59\text{ Bqkg}^{-1}$ respectively. Radiologically dangerous metrics, with the exception of some absorbed dose rate values, were determined to be under the limit as well. However, every sample of tile exceeded the indoor and outdoor dosage limits, and a few samples of granite and paint also exceeded the outdoor dose limits. To prevent unwanted radiation exposure to residents, continual radiation level monitoring is thus required, particularly for tile samples.

* Department of Physics, University of Dhaka, Dhaka.

1.37 The Level of Natural Radionuclides in Ground Water and Health Risk Implication

M.M. Mahfuz Siraz, Md. Robiul Hasan*, Afroza Shelley* and S. Yeasmin

The study was conducted to measure the radioactivity level in ground water and to assess the risk of health hazards due to radiation. Activity concentrations of radionuclides in thirty water samples collected from Gaibandha district were measured by Gamma-ray spectrometry using an HPGe detector. The water samples exhibit varying specific activity of ^{226}Ra , ^{232}Th , and ^{40}K , ranging from $1.7\pm 0.1\text{ Bql}^{-1}$ to $2.7\pm 0.2\text{ Bql}^{-1}$, $2.5\pm 0.2\text{ Bql}^{-1}$ to $3.2\pm 0.3\text{ Bql}^{-1}$, and $60\pm 5\text{ Bql}^{-1}$ to $69\pm 7\text{ Bql}^{-1}$, respectively. All radiological hazard parameters are very low, so there is no ecological risk for these water sample.

* Department of Nuclear Engineering, University of Dhaka, Dhaka.

1.38 Radiometric Analysis and Health Risk Evaluation of Soil Samples Surrounding the 1320-Megawatt Coal-Fired Maitree Super Thermal Power Project, Rampal, Bagherhat, Bangladesh

M.M. Mahfuz Siraz, Sheikh Nafis Haider*, Dr. Sabrin Samad*, N. Sultana and S. Yeasmin

This study was done to determine the radioactivity level surrounding 1320-megawatt coal-fired Maitree Super Thermal Power Project, Rampal, Bagherhat and to determine the health dangers associated with radiation exposure. Activity concentrations of radionuclides in thirty soil samples collected from the vicinity 1320-megawatt coal-fired Maitree Super Thermal Power Project, Rampal, Bagherhat of Bangladesh were measured by Gamma-ray spectrometry using an HPGe detector. The activity concentration of ^{226}Ra , ^{232}Th and ^{40}K were ranged from 17 ± 1 to $31 \pm 3\text{ Bqkg}^{-1}$, 29 ± 2 to $51 \pm 5\text{ Bqkg}^{-1}$ and 350 ± 3 to $670 \pm 61\text{ Bqkg}^{-1}$ respectively, with an average of 25 ± 2.07 , 40.27 ± 3.6 and $515.33 \pm 48.2\text{ Bqkg}^{-1}$ respectively. The average values of ^{226}Ra and ^{232}Th were less than the world average values, but the average value of ^{40}K was higher than the world average. The outdoor absorbed dose rate in nineteen soil samples and indoor absorbed dose rate in two soil samples exceeded the world average values. All other radiological hazard parameter values are lower than recommended safety values.

* Department of Nuclear Engineering, University of Dhaka, Dhaka.

1.39 Examining the Presence of Radioactivity and Health Risk in Soil Samples around the Bheramara 410 MW Combined Cycle Power Plant

M.M. Mahfuz Siraz, Rajikul Islam*, Dr. Afroza Shelley* and S. Yeasmin

Thirty soil samples were collected from the Bheramara 410MW Combined Cycle Power Plant, Bheramara, Kushtia, Bangladesh, and their radioactivity levels were determined using a High Purity Germanium (HPGe) Detector with a relative efficiency of 30%. In this study, no artificial radionuclides were found. The activity concentrations of ^{226}Ra , ^{232}Th and ^{40}K in soil samples ranged from 20 ± 2 to $28 \pm 3\text{ Bqkg}^{-1}$, 25 ± 2 to $41 \pm 4\text{ Bqkg}^{-1}$, and 310 ± 29 to $440 \pm 41\text{ Bqkg}^{-1}$, respectively. All radiological hazard parameter values are lower than recommended safety values.

* Department of Nuclear Engineering, University of Dhaka, Dhaka.

1.40 Assessment of Natural Radionuclides in Soil Samples Collected from Industrial Areas of Chittagong City, Bangladesh

M.M. Mahfuz Siraz, Shahidul Islam Shawon*, Dr. Afroza Shelley* and S. Yeasmin

Thirty soil samples were collected from the Bheramara 410MW Combined Cycle Power Plant, Bheramara, Kushtia, Bangladesh, and their radioactivity levels were determined using a High Purity Germanium (HPGe)

Detector with a relative efficiency of 30%. In this study, no artificial radionuclides were found. The activity concentrations of ^{226}Ra , ^{232}Th and ^{40}K in soil samples ranged from 20 ± 2 to 28 ± 3 Bqkg $^{-1}$, 25 ± 2 to 41 ± 4 Bqkg $^{-1}$, and 310 ± 29 to 440 ± 41 Bqkg $^{-1}$, respectively. All radiological hazard parameter values are lower than recommended safety values.

* Department of Nuclear Engineering, University of Dhaka, Dhaka.

1.41 Measurement of Radioactivity & Assessment of Radiological Hazard in Soil Samples Collected from Siddirganj Combined Cycle Power Plant, Narayanganj, Bangladesh

M.M. Mahfuz Siraz, Mehedi Hasan*, Mohammad Monzur Hossain Khan*, N. Sultana and S. Yeasmin

Using gamma-ray spectrometry, a high purity germanium (HPGe) detector was utilized to evaluate the radioactivity of 20 soil samples that were collected from industrial areas of Chittagong city, Bangladesh. The activity concentrations of ^{226}Ra , ^{232}Th and ^{40}K vary from 8 ± 1 to 18 ± 1 Bqkg $^{-1}$, 15 ± 1 to 35 ± 3 Bqkg $^{-1}$ and 192 ± 17 to 420 ± 35 Bqkg $^{-1}$ respectively. Comparing the results of radiological hazard parameters to national and international safety standards revealed that they fell within the designated safety thresholds.

* Department of Nuclear Engineering, University of Dhaka, Dhaka.

1.42 Assessment of Radioactivity and Radiological Hazard in Soil Samples collected from Payra 1320 MW Thermal Power Plant in Patuakhali, Bangladesh

M.M. Mahfuz Siraz, Md. Ashik Reza*, Mohammad Monzur Hossain Khan*, N. Sultana and S. Yeasmin

In this study high purity germanium (HPGe) detector was used for gamma-ray spectrometry to assess the radioactivity in 30 soil samples obtained from the Payra 1320 MW Thermal Power Plant in Patuakhali, Bangladesh. The specific activity of the soil samples ranged from 19 ± 1 Bqkg $^{-1}$ to 32 ± 3 Bqkg $^{-1}$ for ^{226}Ra , from 31 ± 3 Bqkg $^{-1}$ to 90 ± 9 Bqkg $^{-1}$ for ^{232}Th , and from 420 ± 39 Bqkg $^{-1}$ to 870 ± 79 Bqkg $^{-1}$ for ^{40}K . The results of the radiological hazard parameters were found to be within prescribed safety thresholds when compared to national and international safety standards.

* Department of Nuclear Engineering, University of Dhaka, Dhaka.

1.43 A Pioneering Study of the Radiological Mapping in the World's Largest Mangrove Forest (the Sundarbans) and Implications for the Public and Environment

M.M. Mahfuz Siraz, Jubair Al Mahmud*, Md. Jafor Dewan & S. Yeasmin

This first-ever detailed study of natural radioactivity in soil samples collected from seven tourist destinations within the Sundarbans, the world's largest mangrove forest, was conducted using HPGe gamma-ray spectrometry. Although the activity levels of ^{226}Ra (11 ± 1 – 44 ± 4) Bqkg $^{-1}$ and ^{232}Th (13 ± 1 – 68 ± 6) Bqkg $^{-1}$ generally align with global averages, the concentration of ^{40}K (250 ± 20 – 630 ± 55) Bqkg $^{-1}$ was observed to surpass the worldwide average primarily due to factors like salinity intrusion, fertilizer application, agricultural runoff, which suggests the potential existence of potassium-rich mineral resources near the study sites. The assessment of the hazard parameters indicates that the majority of these parameters are within the recommended limits.

* Department of Nuclear Engineering, University of Dhaka, Dhaka.

1.44 Distribution of Radionuclides from Coal-fired Brick Kilns operating on the Outskirts of Dhaka City and the Consequent Radiological Effects on Human Health and the Environment

M.M. Mahfuz Siraz, M.D.A. Rakib*, Md. Shafiqul Islam* & S. Yeasmin

It was determined that the range of activity concentrations of ^{226}Ra , ^{232}Th , and ^{40}K are (19 ± 3.04 – 38 ± 4.94); (39 ± 5.85 – 57 ± 7.41) and (430 ± 51.60 – 570 ± 68.40) Bqkg $^{-1}$ respectively ; with the concentrations of ^{232}Th and ^{40}K being higher than the global average. Bottom ash deposition in lowlands, fly ash buildup in soils, and the fallout of micro-particles that absorb the minerals released from coal during burning are all probable causes of the elevated radioactivity levels. ^{137}Cs was found in one of the sample locations, which could indicate that the feed coal had been somehow contaminated prior to use. Most estimates of outdoor absorbed dose rate, and a

few values of indoor absorbed dose rate, total annual effective dose, gamma level index, and excess lifetime cancer risk, are higher than the respective global average values which indicate that brick kiln workers and nearby residents are not safe from long exposures to the terrestrial ionizing radiation.

* Department of Nuclear Engineering, University of Dhaka, Dhaka.

1.45 Assessment of Radioactivity Level and Associated Radiological Hazard in Fertilizer from Dhaka

M.M. Mahfuz Siraz, Z. Hossain & S. Yeasmin

A total of 30 samples of various kinds of fertilizer produced in different factories in Dhaka megacity were analyzed to quantify the concentrations of primordial radionuclides using HPGe detector. Among the analyzed samples, average (range) concentration of ^{40}K was found to be 9920 ± 1091 (8700 ± 957 - 11500 ± 1265), 9100 ± 1001 (8600 ± 946 - 9600 ± 1056), 2565 ± 282 (2540 ± 279 - 2590 ± 285) and 3560 ± 392 (2620 ± 288 - 4500 ± 495) Bqkg^{-1} in the samples of Muriate of Potash Fertilizer, Sulphate of Potash Fertilizer, Humic Acid Fertilizer, and NPKS Fertilizer, respectively. Elevated concentration of ^{226}Ra was found in Triple Super Phosphate Fertilizer with a mean (range) of 335 ± 37 (290 ± 32 - 380 ± 42) Bqkg^{-1} . The higher activity of ^{40}K can be linked to the greater levels of elemental potassium in phosphate fertilizer. Elevated concentrations of radionuclides may also result from variations in chemical processes as well as the local geology of the mining areas where the raw materials extracted for fertilizer production.

* Department of Nuclear Engineering, University of Dhaka, Dhaka.

1.46 Evaluation of Radioactivity in Soil and Rock Samples from an Undiscovered Sea Beach in the Southeastern Coastline of Bangladesh and Associated Health Risk

M.M. Mahfuz Siraz, Md. Hossain Kamal*, Zulfiqar Hasan Khan* & S. Yeasmin

This study marks the first-ever assessment of radiological hazards linked to the sands and rocks of Patuarteek Sea Beach, situated along one of the world's longest sea beaches in Cox' Bazar of Bangladesh. Through the utilization of an HPGe detector, a comprehensive analysis of the activity concentrations of ^{226}Ra , ^{232}Th and ^{40}K was conducted, and their activity ranged from 7 - 23 Bqkg^{-1} , 9 - 58 Bqkg^{-1} and 172 - 340 Bqkg^{-1} , respectively in soils, and 19 - 24 Bqkg^{-1} , 27 - 39 Bqkg^{-1} , 340 - 410 Bqkg^{-1} , respectively in rocks. Some sand samples exhibited elevated levels of ^{232}Th , while the rock samples displayed higher levels of ^{40}K compared to the global average.

* Department of Physics, University of Dhaka, Dhaka.

1.47 Assessing Radioactivity Levels in Soil Surrounding Steel Production Facilities: A Pioneering Investigation in Bangladesh

M.M. Mahfuz Siraz, Z. Hossain & S. Yeasmin

A pioneering study was conducted to assess the radioactivity in forty-four soil samples collected from the environs of sixteen different steel mills in the megacity of Dhaka, Bangladesh, using high-purity germanium (HPGe) γ -ray spectrometry. The results indicated activity ranges of 6 - 37 Bqkg^{-1} , 6 - 42 Bqkg^{-1} , and 101 - 470 Bqkg^{-1} for ^{226}Ra , ^{232}Th , and ^{40}K , respectively, in the soil samples. Radiological hazard parameters were evaluated, and none exceeded the recommended limits established by various international organizations. Collectively, these findings emphasize that the soil samples procured from the vicinity of the steel mills do not pose an immediate and substantial threat to the local community concerning radiation hazards.

1.48 Measurement of Radioactivity in Soils of Karamjal and Harbaria Mangrove Forest of Sundarbans for Establishment of Radiological Database

M.M. Mahfuz Siraz, Z. Hossain & S. Yeasmin

This work presents the first in-depth study of soil radioactivity in the mangrove forest of Bangladesh part of the Sundarbans. The activity concentrations of most of the ^{226}Ra (14 ± 2 to 35 ± 4 Bqkg^{-1}) and ^{232}Th (30 ± 5 to 50 ± 9 Bqkg^{-1}) lie within the world average values, but the ^{40}K concentration (370 ± 44 to 660 ± 72 Bqkg^{-1}) was found to have exceeded the world average value. The evaluation of radiological hazard parameters revealed that the outdoor absorbed dose rate ($\text{max. } 73.25 \text{ nGyh}^{-1}$) and outdoor annual effective

dose (max.0.09 mSvy-1) for most samples exceeded the corresponding world average values. The elevated concentration of ^{40}K is mainly due to the salinity intrusion, usage of fertilizers and agricultural runoff, and migration of waste effluents along the riverbanks.

1.49 Determination of Radioactivity in Environmental Samples Collected from the 32 km Radial Distances of Rooppur Nuclear Power Plant

S. Pervin, N. Sultana, S. Banik, J. Ferdous, A. Joydhar and S. Yeasmin

To prepare baseline data of environmental radiation and radioactivity monitoring around the Rooppur Nuclear Power Plant (RNPP) site, different environmental samples were collected from the 32 km radial distance of RNPP. The sampling was conducted in 17-30 January, 2022. Total 92 samples (surface water = 44, bottom water = 14, sediment = 14, aquatic vegetation = 12 and air samples =8) were collected from the 32 km radial distance of RNPP. Among these samples 85 samples were processed following the standard procedures as International Atomic Energy Agency (IAEA) guidelines. After preparation samples will be measured by using high-purity germanium (HPGe) detector. The work is in progress.

1.50 Measurement of Radon (^{222}Rn) Activity Concentration in Drinking Water of Dhaka City using RAD7 Detector

Amena Mehazabi, S. Pervin, Obaydur Rahman, S.Yeasmin

Twenty-four samples were taken from ground water in Dhaka WASA and tested for ^{222}Rn concentration using a RAD7 detector with RAD H₂O accessory. The twenty-four ground water samples gave a mean value of $3.93 \pm 1.03 \text{ BqL}^{-1}$, ranging from $0.56 \pm 0.11 \text{ BqL}^{-1}$ to $7.8 \pm 0.90 \text{ BqL}^{-1}$. All of the samples activity concentrations were lower than the USEPA and WHO recommended MCLs of 11.1 BqL^{-1} and 100 BqL^{-1} , respectively. The values revealed in this study were compared to those found in similar studies in other nations, and parallels were discovered.

*Department of Physics, Mawlana Bhashani Science and Technology University, Tangail, Bangladesh

1.51 Study of Gross Alpha and Gross Beta Activity in Drinking Water Collected from Manikganj District Using Zinc Sulphide Scintillation Detector (zns)

M. Halder, S. Pervin, M.M. Haider, S. Yeasmin

Twenty five water samples were collected from tube-well. The study was performed by using Zinc Sulphide Scintillation detector. The model of the detector is MPC-900-DP. The gross alpha activity was ranged from $0.0004 \pm 0.0003 \text{ BqL}^{-1}$ to $0.0063 \pm 0.0008 \text{ BqL}^{-1}$, with an average value of $0.0023 \pm 0.0003 \text{ BqL}^{-1}$. The gross beta activity concentration was ranged from $0.0004 \pm 0.0002 \text{ BqL}^{-1}$ to $0.0733 \pm 0.0100 \text{ BqL}^{-1}$ with a mean value of $0.0241 \pm 0.0017 \text{ BqL}^{-1}$. The recommended value of gross alpha is 0.1 BqL^{-1} and 1 BqL^{-1} for gross beta activity. The result showed that the natural activities of alpha and beta emitting radionuclides in drinking water samples did not exceed WHO recommended levels and compare with the data available in other parts of the world.

*Department of Physics, Mawlana Bhashani Science and Technology University, Tangail, Bangladesh

1.52 Study and Investigation of the Trend of Occupational Exposure in the Field of Industrial Radiography

M. Hassan, S. Hossain, A. K. M. M. Rahman, Z. Hossain, and S. Yeasmin.

Finding the occupational dose received by the industrial workers and observes the dose variation with time which is the measure of safety issue in field of industrial radiography. The occupational radiation exposures for 453 workers were investigated in the fields of industrial radiography throughout Bangladesh in 2023 by using Thermoluminescent dosimeter (TLD). A Harshaw TLD reader (Model 4500) was used to measure the effective dose on a quarterly basis throughout the year.

1.53 Study of Thermoluminescence (TL) Properties of Environmental Samples for Accidental Dosimetry

S. Hossain, A. K. M. M. Rahman, M. Hassan, Z. Hossain, and S. Yeasmin

Finding fortuitous materials with dosimetric qualities that may be utilized to calculate the radiation dose that victims may have exposed in case of nuclear/radiological emergency. Five smart phone glass screen protectors from local retailers were taken into account. The materials were prepared for further processing. Following that, the materials were irradiated between 0.5 to 8 Gy to study the TL glow curves. Energy dispersive X-ray (EDX) and Raman spectroscopy analysis of the materials were conducted for structural characterization. It can be demonstrated that the glassy samples under study may serve as competitive fortuitous dosimeters for radiation accident dosimetry, based on their TL glow curves, linear dose response and sensitivity.

1.54 Occupational Radiation Exposure among the Workers in Major Medical Practices

S. Hossain, A. K. M. M. Rahman, M. Hassan, M. M. M. Siraz, S. Pervin, N. Sultana, N. Hassan, Z. Hossain, M. S. Rahman and S. Yeasmin

To understand the complete situation of the effectiveness of radiation protection practices in the workplace, especially in the medical fields where ionizing radiation is used for the purpose of diagnostic and therapy. The occupational radiation exposures for 11347 workers were investigated in the fields of radiotherapy, diagnostic radiology, and nuclear medicine throughout Bangladesh in 2023-24 by using thermoluminescent dosimeter (TLD). A Harshaw TLD reader (Model 4500) was used to measure the effective dose on a quarterly basis throughout the year. The database was prepared and recorded on the basis of the value of personal dose equivalent ($H_p(10)$).

1.55 Measurement of Radioactivity in The Surface Water and Sediment Samples Collected from the 32 Sq.Km Radial Distances of Rooppur Nuclear Power Plant (RNPP)

S. Hossain, M. M. Mahfuz Siraz, S. Pervin, N. Sultana, N. Hassan, Z. Hossain, J. Ferdous and S. Yeasmin

According to the decision made by the BAEC, the surface-water & sediment samples collection and analysis were performed by the Health Physics Division (HPD), Atomic Energy Centre (AEC), Dhaka for background radiation level monitoring. Forty-four (44) water samples were taken at 32 sq.km radial distances around the RNPP site and a total of nine (09) sediment samples among the twenty locations were possible to collect at 32 sq.km radial distances around the RNPP site in order to quantify the natural and artificial radioactivity. A high purity germanium (HPGe) detector was used to measure the radioactivity of all samples and counting time was 1,20,000 seconds. To reduce the level of uncertainty in the net counts, an identical counting period was used for background and sample measurements. For water samples, the radioactivity level of ^{226}Ra varied within the range of 2.1 ± 0.4 to $6.3 \pm 0.9 \text{ BqL}^{-1}$ and ^{232}Th varied within the range of 2.2 ± 0.5 to $5.5 \pm 1.1 \text{ BqL}^{-1}$. The level of ^{40}K varied within the range of 64 ± 8 to $121 \pm 14 \text{ BqL}^{-1}$. In any of the samples, there was no indication of any artificial radionuclide. In sediment samples, the radioactivity level of ^{226}Ra varied within the range of 14.6 ± 1.6 to $55 \pm 5 \text{ Bqkg}^{-1}$ and ^{232}Th varied within the range of 20.4 ± 2.2 to $89 \pm 8 \text{ Bqkg}^{-1}$. The level of ^{40}K varied within the range of 300 ± 33 to $540 \pm 59 \text{ Bqkg}^{-1}$.

1.56 Determination of Radioactivity in Environmental Samples Collected from the 32 km Radial Distances from Rooppur Nuclear Power Plant

N. Hassan, M.M. Mahfuz Siraz, S. Pervin, N. Sultana, Z. Hossain, A. Joydhar, J. Ferdous & S. Yeasmin

To measure the radioactivity and assess the radiological hazard associated with various environmental samples. To prepare baseline data of environmental background radiation around the Rooppur Nuclear Power Plant (RNPP) site, total 87 environmental samples (Surface water 44, sand and sediment-19, aquatic vegetation-04, for radon measurement -20 surface water) were collected in 02-13 January, 2023 from the 32 km radial distance of RNPP. All samples were processed following the standard procedures as International Atomic Energy Agency (IAEA) guidelines. After preparation, samples will be measured by using high-purity germanium (HPGe) detector with relative efficiency of 30%. The work is in progress.

1.57 Assessment of Gross Alpha/ Beta Activity in Various Water Collected from Different Pharmaceutical Companies of Bangladesh

N. Sultana, S. Pervin, M.M.M. Siraz, N. Hassan, M. Begum, S. Hossain, M. Hasan and S. Yeasmin

Twenty two pharmaceutical water samples were collected randomly from different pharmaceutical companies which situated in different locations of Bangladesh. The gross alpha and gross beta activity in pharmaceutical water samples will be measured by using Zinc sulfide (ZnS) scintillation detector. All samples were collected and prepared according to the EPA 900 method. Till now twenty samples were measured by the detector. Among the measured sample minimum detected alpha activity is 0.0014 Bq/L, beta activity is 0.0127 Bq/L and maximum alpha activity is 0.0122 Bq/L, beta activity is 0.0213 Bq/L. Further work is in progress.

1.58 Measurement the Activity of Gross Alpha/Beta on Surface Water of BCMCL area

S. Yeasmin, N. Sultana and M.M.M. Siraz

Among 50 samples 30 samples were prepared and measured for gross alpha/beta value with a ZnS scintillation counter. The calculated activity of gross alpha value ranges from 0.00045 ± 0.0006 to 0.01358 ± 0.0011 BqL⁻¹ with a mean value of 0.00487 ± 0.0011 BqL⁻¹ and gross beta value range from 0.00082 ± 0.0206 to 0.36576 ± 0.0208 BqL⁻¹ with an average value of 0.09576 ± 0.0208 BqL⁻¹. The measured AED for alpha radiation range was 0.00012 ± 0.0002 to 0.00355 ± 0.0003 mSv/yr with a mean value of 0.00127 ± 0.0003 mSv/yr and range of AED for beta radiation was 0.00021 ± 0.0054 to 0.05106 ± 0.0054 mSv/yr with a mean value of 0.02502 ± 0.0054 mSv/yr. Further work is in progress.

1.59 Assessment the Activity of Radon Concentration on Surface Water at Different Time Near RNPP Site, Bangladesh

N. Sultana, M.M.M. Siraz, S. Pervin, N. Hasan, Z. Hossain and S. Yeasmin

Surface water samples collected 3 times from each 20 specific point for investigate the difference of radon activity. From 1st sampling, Radon concentration founds between the values 0.062 ± 0.029 to 0.712 ± 0.145 BqL⁻¹ with an average Radon concentration of 0.247 ± 0.059 BqL⁻¹. In 2nd sampling, Radon concentration founds between the values 0.07 ± 0.035 BqL⁻¹ to 0.385 ± 0.24 BqL⁻¹ with an average value of 0.194 ± 0.114 BqL⁻¹. At the last study, Radon concentration founds between the values 0.035 ± 0.07 BqL⁻¹ to 0.455 ± 0.239 BqL⁻¹ with an average value of 0.227 ± 0.141 BqL⁻¹. Further work is in progress.

2. Manpower Development (Training/Fellowship/Workshop/Meeting)

2.1 Attend in Training/Fellowship/Workshop/Meeting

Sl. No	Title of the program	Date	Place	Number of participants
1.	International Conference on Physics-2024	09 to 11 May 2024	Atomic Eenergy Centre Dhaka	08
2.	Workshop on Bangladesh National Single Window System	22 April 2024	BRAC Center Inn (75 Mohakhali, Dhaka, Bangladesh)	02
3.	Advance Instructor Training Course 2023	14 – 22 November 2023	Japan Atomic Energy Agency	01
4.	Instructor Training Course 2023	05 – 26 July 2023	Japan Atomic Energy Agency	01
5.	BCSIR Congress-2023	08–10 March, 2024	BCSIR, Dhaka	02

2.2 Organize Training /Fellowship/Workshop /Meeting

Sl. No	Title of the program	Date	Place	Number of participants
1.	Training on review, assess and improve the technical capabilities of service providers including the implementation of management system by IAEA Expert mission	05 to 09 May 2024	Health Physics Division, Atomic Energy Centre, Dhaka	12

2.	In-House training on commissioning and quality control of Gamma spectrometry system.	11-15 February 2024	Health Physics Division, Atomic Energy Centre, Dhaka	10

3. Oral /Poster Presentation in Seminar/Symposium/Conference(National and International)

Name of the Participant	Title of oral/poster presentation	Title of the event	Organizer	Date	Place
Dr. A.K.M. Mizanur Rahman	Synthesis and Investigation of Structural and Thermoluminescence Properties of LiCaPO_4 Phosphor for Radiation Dosimetry Applications	XXIII International Symposium on Solid State Dosimetry	UNIVERSIDAD DE CÓRDOBA	25-29 September 2023	Monteria Colombia
	Structural and Thermoluminescence Properties of ZnLiBO_3 Phosphor for Radiation Dosimetry Applications	XXIII International Symposium on Solid State Dosimetry	UNIVERSIDAD DE CÓRDOBA	25-29 September 2023	Monteria Colombia
Dr. Mahbuba Begum	Assessment of Radioactivity Concentration of Gas Reservoir Well Core Samples of Shahbazpur and Saldanadi Gas Field, Bangladesh	BCSIR Congress-2023	BCSIR	08–10 March, 2024	BCSIR, Dhaka
	Assessment of Radiation Hazard Indices in Soil and Sediment Samples from Gas Field Environment of Fenchuganj, Bangladesh	BCSIR Congress-2023	BCSIR	08–10 March, 2024	BCSIR, Dhaka
	Radiation Hazard Indices Assessment in Soil and Sediment Samples from Shahbazpur and Saldanadi Gas Field Environment of Bangladesh	BCSIR Congress-2023	BCSIR	08–10 March, 2024	BCSIR, Dhaka
	Chemical Characterization of the Core Samples of Saldanadi Gas Field by Neutron Activation Analysis	BCSIR Congress-2023	BCSIR	08–10 March, 2024	BCSIR, Dhaka
	Radiation Hazard Indices Assessment for Core Samples of Rashidpur and Koilastila Gas Fields of Bangladesh	International conference on physics-2024	Bangladesh Physical Society	09-11 May, 2024	Atomic Energy Centre, Dhaka
	NORM Assessment of Gas Reservoir Core	International conference on physics-	Bangladesh Physical	09-11 May, 2024	Atomic Energy

	Samples of Jalalabad and Sitakundo Gas Fields, Bangladesh	2024	Society		Centre, Dhaka
	Elemental Abundance Assessment of the Core Samples of Fenchuganj Gas Field by Neutron Activation Analysis	International conference on physics-2024	Bangladesh Physical Society	09-11 May, 2024	Atomic Energy Centre, Dhaka
Shikha Pervin	Activity Concentration in Drinking Water of Dhaka City using RAD7 Detector	International conference on physics-2024	Bangladesh Physical Society	09-11 May, 2024	Atomic Energy Centre, Dhaka
Dr. Shahadat Hossain	Smart Phone Glass Screen Protector: A Fortuitous Solution to Measure Radiation Doses in Case of Nuclear or Radiological Accident	International conference on physics-2024	Bangladesh Physical Society	09-11 May, 2024	Atomic Energy Centre, Dhaka
Nazneen Sultana	Assessment of Gross Alpha/Beta Activity in Various water samples used at different pharmaceutical companies in Bangladesh	International conference on physics-2024	Bangladesh Physical Society	09-11 May, 2024	Atomic Energy Centre, Dhaka
	Determination the Activity of Gross Alpha/Beta on Surface Water Collection from BCMCL Area	International conference on physics-2024	Bangladesh Physical Society	09-11 May, 2024	Atomic Energy Centre, Dhaka
Nazia Hassan	Confirmation of ^{137}Cs radionuclides in imported and exportable foodstuffs samples of Bangladesh using of gamma spectrometry system	International conference on physics-2024	Bangladesh Physical Society	09-11 May, 2024	Atomic Energy Centre, Dhaka

4. Collaboration work/ MOU (ADP/FNCA/MEXT/FTC/IAEA/RCA/TC/S&T/CRP/In-house project, Universities, etc.)

To Implement radiation protection program , HPD has been working in collaboration with IAEA, JAEA (Japan) as well as government of Bangladesh in different projects such as IAEA/RCA, IAEA/Non-RCA, IAEA CRP, ITC followed by FTC, ADP etc.

Collaboration Project with MOST, GOB & IAEA:

- RAS/9093 -Strengthening Technical Services in Occupational Radiation Protection in Compliance with the International Basic Safety Standards
- Special Research Allocation Project: 2023-2024 under MOST, GOB

To enhance knowledge on radiological science the senior scientists of HPD have been delivering theoretical lectures in the field of Health physics & Radiation Protection in the following areas:

- MD course in Nuclear Medicine (NINMAS)

5. Service Rendered

Sl no.	Name of service provided	Number/Quantity of Sample/Service	Revenue income
1.	Imported and Exportable Food Samples	1378	58,88,887.00/-
2.	Gross Alpha and Gross Beta Service Provided	38	340000.00/-
3.	Individual Monitoring Service	12946	13056100.50/-

Materials Science Division, AECD

Objective

The research pursued by the Materials Science Division, Atomic Energy Centre Dhaka constitutes the development of various surfactant functionalized mediators by chemical co-precipitation, sol-gel, hydrothermal, thermal decomposition techniques for the application at clinically relevant conditions as MRI/MRA contrast agent, and hyperthermia mediator. Surfactant functionalized mediators were carried out by using X-ray diffraction, transmission electron microscopy, Raman spectroscopy, Fourier transforms infrared spectroscopy, UV-vis spectroscopy, atomic absorption spectroscopy, dynamic light scattering, zeta potential, differential scanning calorimetry/thermogravimetric analysis, physical properties measurement system, high-pressure liquid chromatography. By cytotoxicity and histopathology studies, we examined the viability of surfactant functionalized mediators. We further studied the crystallization of lysozyme protein with appropriate buffers and reagents and the determination of crystal structure using a protein crystallographer. We synthesized ultra-small scale composites of hydroxyapatite-oxide-carbonaceous materials (graphene, graphene oxide, carbon nanotube), followed by the hydrothermal method with the subsequent toxicity studies. High-efficiency nano urea was developed, and enhanced efficiency in rice production was observed using pot experiments. We carried out the development of novel magnetic materials for giant magnetoresistance, magnetocaloric, and multiferroic applications. Performance studies of novel thermo-luminescent materials were carried out for the dosimetry applications. We developed and characterized the fluorite and pyrochlore using several material characterization techniques for applications in nuclear cladding materials. Organic-inorganic hybrid materials were developed for environmental remediation by the removal of heavy elements from tannery wastewater. We developed organic-inorganic hybrid materials for photocatalytic degradation of industrial effusion.

Programme

The programmes of this division are as follows:

- AECD-MSD-PA01-P01 The development of various surfactant functionalized mediators at clinically relevant conditions for efficient magnetic fluid hyperthermia therapy and magnetic resonance imaging and angiography
- AECD-MSD-PA01-P02 Synthesis and characterizations of protein and small molecules for drug development
- AECD-MSD-PA01-P03 Development of ultra-small hydroxyapatite-carbonaceous composite and other materials for the orthopedic and dental treatment
- AECD-MSD-PA01-P04 Development of high efficiency nano fertilizers and pesticides to protect environmental pollution
- AECD-MSD-PA02-P01 Development of Novel Magnetic Materials for Giant Magnetoresistance, Magnetocaloric, Multiferroic Applications
- AECD-MSD-PA02-P02 Development of Sustainable Smart Materials to Harvest Renewable Energy
- AECD-MSD-PA02-P03 Robotics and Artificial Intelligence for biomedical and nuclear applications: Bridging Theory with Real-World Applications
- AECD-MSD-PA03-P01 Development of Novel Thermo-luminescent Device, Radio-luminescence and optically stimulated luminescence Materials for Dosimetry Applications
- AECD-MSD-PA03-P02 Development of high resilient structural materials for nuclear reactors
- AECD-MSD-PA03-P03 Benefaction of commercially important materials acquired from the Cox's Bazar beach sand and other primary sources of raw materials

- AECD-MSD-PA04-P01 Development of oxide and carbonaceous materials for environmental remediations
- AECD-MSD-PA04-P02 Radioactive waste management by using organic-inorganic hybrid nanomaterials
- AECD-MSD-PA04-P03 Recycling and reprocessing of used materials from end-of-life product

1. Research and Development Work

1.1 Development of Artificially Engineered Nanoparticles by Surface Modification and their Biomedical Applications

S. Manjura. Hoque, M. N.I. Khan, M. Al-Mamun, H. N. Das, S. I. Liba, R. Rashid, M.R. Hasan, A. Parveen, A. A. Begum, K. H. Fakir, N. Begum, A. Islam *

The effectiveness of cobalt-substituted magnesium ferrite $\text{Mg}_{1-x}\text{Co}_x\text{Fe}_2\text{O}_4$ (MCFO) ($0 \leq x \leq 1$ with $\Delta x = 0.1$) and polymer nanohybrids for biomedical applications, partially as the contrast agent for magnetic resonance imaging/angiography and thermotherapeutic applications for malignant lesion, was investigated by synthesizing these nanoparticles using the chemical co-precipitation method. Particle size, shape, distribution, and coating agent affect magnetization and anisotropy and particle volume substantially control the relaxivities and specific loss of power can be either beneficial or detrimental by hysteresis loss. When the ratio of the MRI negative relaxivity values (r_2) to the positive reference value (r_1) is high, the contrast agent has a negative effect, and vice versa when the ratio is low. The values of r_1 and r_2 are highly sensitive to the nanoparticle's magnetic and structural characteristics. Again, SLP is highly dependent on magnetic anisotropy, and limited anisotropy will always increase the value of SLP, leading to better hyperthermia performance. Brownian relaxation is frustrated by the large particle size. Anisotropy and structural characteristics were investigated in Co-substituted Magnesium ferrite with an atom fraction increase of $x = 0.1$. MRI/MRA contrast agents were studied using particles of all compositions. Particle size dependence SLP and temperature rise for hyperthermia and/or laser ablation were studied by varying the size of the particles through controlled annealing at 200°C, 400°C, 600°C and 800°C, and then encapsulating the particles in chitosan. This study aims to learn the structure-property relationship and their effect on magnetic nanoparticle-mediated MRI and thermotherapy using MCFO and chitosan/dextran/polyethylene glycol (PEG) nanohybrid.

* Department of Physics, University of Dhaka, Dhaka

1.2 Synthesis of Exchange-spring Coupled $\text{CaFe}_{12}\text{O}_{19}/\text{MnFe}_2\text{O}_4$ Nanocomposites by Co-precipitation Method and Study the Effectiveness of Dextran Coated Nanocomposites in Hyperthermia for Cancer Treatment

S. Manjura. Hoque, M. N.I. Khan, M.M. Haque, M. Al-Mamun, H. N. Das, S. I. Liba, R. Rashid, M.R. Hasan, A. Parveen, A. A. Begum, K. H. Fakir, N. Begum, S. A. Lima *

The $\text{CaFe}_{12}\text{O}_{19}/\text{MnFe}_2\text{O}_4$ nanocomposite ferrite with the hard ($\text{CaFe}_{12}\text{O}_{19}$) and soft (MnFe_2O_4) magnetic phases, were prepared by chemical co-precipitation method. The prepared nanocomposite ferrites were calcined at three different temperatures to form different phases. The structural, morphological, and magnetic properties of nanocomposite ferrites were analyzed by X-ray diffraction (XRD), transmission electron microscope (TEM), room temperature vibrational sample magnetometer (VSM) and Fourier transform infrared spectroscopy (FTIR). The presence of the hard and soft phases has been confirmed without any secondary phase from XRD analysis, including the formation of nanocomposite ferrite. The crystallite size is found to be in the range of 24-44 nm calculated by Scherrer's formula. The TEM revealed hexagonal platelets of $\text{CaFe}_{12}\text{O}_{19}$ with spinel MnFe_2O_4 particles with an average particle size of 48 nm formed at the surface of $\text{CaFe}_{12}\text{O}_{19}/\text{MnFe}_2\text{O}_4$ nanocomposite. Saturation magnetization (M_s), remanent magnetization (M_R), remanence ratio (M_R/M_s), coercivity (H_c), and magnetic anisotropy (k) of room temperature were evaluated by VSM. The magnetic measurements have displayed enhancement in coercivity and magnetization for $\text{CaFe}_{12}\text{O}_{19}/\text{MnFe}_2\text{O}_4$, indicating that the nanocomposite possessed excellent exchange coupling. The nanocomposite enhanced energy product $(BH)_{\max}$ made it highly promising for biomedical applications such as hyperthermia. The exchange spring coupled magnetic nanocomposite was coated with dextran to make it biocompatible. The coating was confirmed using Fourier transformed infrared spectroscopy (FTIR).

Cytotoxicity tests on Vero cell lines showed that the coated nanoparticles had an excellent (>95%) cell survival rate.

* Department of Physics, University of Dhaka, Dhaka

1.3 Correlation of Physico-chemical Properties with SLP and $T_{\max}$ Attained by RF- induction Heating of Mg-rich Mg-Co Nanoferrite for Different Particle Sizes

S. Manjura Hoque, M. N.I. Khan, M. Al-Mamun, H. N. Das, S. I. Liba, R. Rashid, M.R. Hasan, A. Kumar, A. Parveen, A. A. Begum, K. H. Fakir, N. Begum, S. Akter *

Surface-modified $\text{Mg}_{0.8}\text{Co}_{0.2}\text{Fe}_2\text{O}_4$ can be a potential candidate for magnetic fluid hyperthermia. The chemical co-precipitation method was used for $\text{Mg}_{0.8}\text{Co}_{0.2}\text{Fe}_2\text{O}_4$ nanoparticle synthesis which is one of the best methods to control the size of nanoparticles. The synthesized particles were then annealed at different temperature. The pattern demonstrated that crystallinity increases with increasing annealing temperature and nanoparticles of different size in the range of 2-23 nm nanoparticles were formed in the temperature range 400-800°C. The characteristic absorption bands of the functional groups in the nanoparticles were determined by FTIR analysis. The peak position of functional groups was modified for PEG coating. The distribution of particle size and shape was investigated from the SEM and TEM images. The nanoparticles had nearly spherical morphology. The crystallinity of $\text{Mg}_{0.8}\text{Co}_{0.2}\text{Fe}_2\text{O}_4$ nanoparticles with particle size 2-23 nm was confirmed by the presence of lattice fringe in the HRTEM images. By using dynamic light scattering at room temperature 25°C, the hydrodynamic diameter and polydispersity index (PDI) of nanoparticles coated with PEG were determined. Hydrodynamic size and homogeneity increased with an increase in particle size. Size also increased and nanoparticle become homogeneous in solutions for coating. Physical Properties Measurement System (PPMS) was used to determine the magnetic parameters such as saturation magnetization, coercivity, and remanance. According to the findings of the hyperthermia study, the temperature reached by the PEG-coated nanoparticles with a size of 10 nm and a concentration of around 4 mg/ml was >60°C.

* Department of Physics, University of Dhaka, Dhaka

1.4 Controlled Phase and Morphology: Improving the Magnetic, Electrical, Optical and Photocatalytic Activities of Cr-doped SnS_2 Nanoparticles Synthesized via the Hydrothermal Method

S. Manjura Hoque, M. N. I. Khan, H.N. Das, S. I. Liba, R. Rashid, A. Kumar, A. Parveen A. A. Begum, N. Begum, A. Paul*

$\text{Sn}_{1-x}\text{Cr}_x\text{S}_2$ (here $x=0.0, 0.02, 0.04, 0.06, 0.08$ and 0.1) were successfully prepared via hydrothermal where Stannic chloride pentahydrate ($\text{SnCl}_4 \cdot 5\text{H}_2\text{O}$), thioacetamide ($\text{C}_2\text{H}_5\text{NS}$) and chrome chloride ($\text{CrCl}_3 \cdot 6\text{H}_2\text{O}$) were used as source of Sn^{4+} ions, S^{2-} ions and Cr^{3+} ions respectively. The samples were characterized by XRD, FTIR, XPS, SEM, EDS, UV-vis and the structure of nanoparticles was found to be hexagonal. By using X-ray diffraction, the structure and lattice parameter were identified and analyzed using Scherer's method to calculate the crystallite size. FTIR was used to observe the existence of functional groups in the material where Sn-S bonds were present in every one of the produced pristine and Cr-doped SnS_2 nanoparticles. FESEM revealed that the morphological properties of the nanoparticles included several hexagonal grains. Energy-dispersive X-ray analysis was used to determine the elemental composition of both the pristine and Cr-doping concentration of Cr, SnS_2 nanoparticles become super paramagnetic from ferromagnetic. The band gap values for the pristine and Cr-doped SnS_2 nanoparticles calculated from the absorbance spectra decreased from 2.53 to 2.08 eV with an increase in doping concentration. The photoluminescence spectra of the pristine SnS_2 and Cr: SnS_2 nanoparticles for excitation wavelength of 420 nm exhibit two strong emission peaks at around 562 and 666 nm. From IV characteristics it has been examined that the resistivity of Cr: SnS_2 nanoparticles increases up to 0.2% of Cr concentration and above that point it decreases.

* Department of Physics, University of Dhaka, Dhaka

1.5 Study of the Effect of Different Additive as Sintering Aids on Structural, Microstructural, and Magnetic Properties of Mg-Cu-Zn Ferrite

S. Manjura Hoque, M. N. I. Khan, H.N. Das, A. Kumar, A. Parveen, A. A. Begum, M.A. Hossain, N. Begum, N. Islam, M. Rahman *

$\text{Mg}_{0.25}\text{Cu}_{0.3}\text{Zn}_{0.45}\text{Fe}_2\text{O}_4$ were synthesized and sintered at 800°C, 900°C, 1000°C and 1100°C for 3 hours followed by solid-state reaction method. 1000°C has been considered as the optimum sintering temperature. The X-ray diffraction patterns confirm the single-phase cubic spinel structure of all the synthesized samples. The lattice parameter is slightly decreased for Bi addition with the exception of initially being decreased and then increased for Mo addition. Fourier transforms infrared absorption bands of samples reveal that the frequency band appeared in the high frequency (530-538 cm^{-1}) and (532-550 cm^{-1}) which was attributed to the stretching vibrations, while the band appeared in the low frequency bending (350-358 cm^{-1}) and (358- 368 cm^{-1}) which is related to vibrations for Bi_2O_3 and MoO_3 addition respectively. The scanning electron microscopy of samples shows that average grain size is increasing with increasing additives content and elemental analysis reveals that all the elements are present in prepared samples. The initial permeability is constant at lower frequency region and decreases for high frequency region while the imaginary part shows maximum at high frequency region indication ferrimagnetic resonance. The values of saturation magnetization augment with increasing concentration and it is maximum at $x=0.3$ after that it declines for further increasing frequency in both cases. The dielectric properties of the samples showed dispersive behavior following the Maxwell –Wagner type of polarization. The dielectric loss increases with increasing frequency and for higher concentrations of both additives are more resistive less conductive.

* Department of Nuclear Engineering, University of Dhaka, Dhaka

1.6 Holmium Doping in Bismuth Ferrite: A Comprehensive Characterization and Properties Analysis Synthesis by Sol-Gel Auto Combustion

S. Manjura Hoque, M. N. I. Khan, H.N. Das, A. Kumar, A. Parveen, A. A. Begum, M.A. Hossain Begum, N. Islam, M. M. U. Anik *

Multiferroic composites of Holmium-substituted Bismuth ferrites (with $x= 0.00, 0.02, 0.04, 0.06, 0.08, 0.10$) were synthesized via the sol-gel auto-combustion method and subsequently sintered at 600°C for 3 hours and investigated by XRD, FTIR, TEM, UV visible spectroscopy and P-E loop for structural, optical and ferroelectric properties. Phase analysis, lattice constant, bulk density and grain size were studied via X-ray diffraction (XRD). XRD pattern showed that the structure of bismuth ferrite was rhombohedral distorted perovskite structure of space group $R3c$ and average crystallite size was determined to increase (16 nm to 28 nm) with increase in Holmium concentration. The bond formation was confirmed by Fourier Transform Infrared spectroscopy (FTIR) and metal-oxide bonds at 440 cm^{-1} and 528 cm^{-1} in IR spectra confirmed the perovskite structure of bismuth ferrites. Morphology of TEM images was found to be spherical shape and confirms the nano size of the particle with average particle size from 60 nm to 73 nm. SAED patterns of TEM images represent constructive interference from the crystal planes and serve as evidence to the crystallinity of the nanoparticles. UV–visible spectroscopy revealed that energy band gap decreased by increasing the Holmium concentration and it is in between 3.32 eV to 2.64 eV which confirmed the semiconductor behavior across all samples.

* Department of Physics, University of Chittagong, Chittagong

1.7 Synthesis and Characterization of Multifunctional Properties of $\text{Bi}_{0.910}\text{Ho}_{0.10}\text{FeO}_3$ with Variation of Sintering Temperature

S. Manjura Hoque, H. N. Das, S. I. Liba, A. Nahar, A. Parveen, A. A. Begum, K. H. Fakir, N. Begum, U. Maktum *

Nanoparticles with composition $\text{Bi}_{0.90}\text{Ho}_{0.10}\text{FeO}_3$ were synthesized by using sol-gel auto combustion method sintered at 775°C, 800°C, 825°C and 850°C to investigate their structural, morphological, ferro-electrical and optical properties using the corresponding characterization techniques, XRD patterns revealed that the substitution of Ho^{3+} in the place of Bi^{3+} shows hexagonally distorted perovskite structure with $R3c$ symmetry. By measuring in the 4000-250 cm^{-1} range, Fourier transform infrared spectroscopy (FTIR) confirmed the bond formation. Pure phase of the composition of $\text{Bi}_{0.90}\text{Ho}_{0.10}\text{FeO}_3$ from the spectra which is incorporated to the XRD results. The absorption peaks for high temperature (850°C) are sharper than the other lower

temperature. TEM was conducted to characterized the morphology, microstructural analysis, shape and size of the nanoparticles. Using a ferroelectric loop tracer, electric field-dependent ferroelectric properties of the nanoparticles were studied. Ho-substitution in bismuth ferrites enhanced the leakage current which is of the problems faced by the pure bismuth ferrites. UV-Vis-NIR spectroscopy was employed to determine the band gap energy of the synthesized nanoparticles. UV-visible spectroscopy revealed that energy band gap of $\text{Bi}_{0.90}\text{Ho}_{0.10}\text{FeO}_3$ nanoparticles decreased from 2.24 eV to 0.95 eV by increasing the temperature. Based on the acquired data, it can be said that $\text{Bi}_{0.90}\text{Ho}_{0.10}\text{FeO}_3$ is appropriate for use in wave guides, tunable transformers, ME logic devices in electronics and cancer therapeutic applications, gyrators, phase shifters, actuators, transducers, heterogeneous read/write devices, sensors, computer technology and voltage/current converters.

* Department of Physics University of Chittagong, Chittagong

1.8 Study of the Magnetocaloric Properties and Analysis of Critical Behavior of Cobalt Doped Magnesium spinel Ferrite ($\text{Mg}_{1-x}\text{Co}_x\text{Fe}_2\text{O}_4$) for Magnetic Refrigeration Application

S. Manjura Hoque, H. N. Das, S. I. Liba, A. Nahar, A. Parveen, A. A. Begum, K. H. Fakir, N. Begum, S. Hossain *

The magnetic, and magnetocaloric properties of $\text{Mg}_{1-x}\text{Co}_x\text{Fe}_2\text{O}_4$ having respectively, $x=0.0, 0.2, 0.3, 0.4, 0.6, 0.9$ and 1 annealed at 200°C and $x=0.04, 0.6, 0.7, 0.8$ and 1 annealed at 400°C synthesized by chemical co-precipitation method were investigated. Moreover, in order to facilitate the understanding of the magnetocaloric effect of the $\text{Mg}_{1-x}\text{Co}_x\text{Fe}_2\text{O}_4$, their critical behavior was also studied for a couple of samples with compositions $x=0.4, 0.6$ and 1 annealed both at 200°C and 400°C respectively. Arrott plots confirmed that almost all the samples underwent second-order ferromagnetic (FM) to paramagnetic (PM) phase transitions expect for those with $x=0.2, 0.3, (200^\circ\text{C})$ and $x=0.4 (400^\circ\text{C})$, underwent the first order ferromagnetic to paramagnetic phase transitions. A consistent increment in the Curie temperature was realized for the increase in the cobalt (Co) content in the range between $x=0$ and $x=1$ and also for the increasing sintering temperature. The maximum entropy change (ΔS_M^{max}) and the relative cooling power (RCP) value were obtained respectively as 30.7 J/kg-K-1 and was recorded for the composition $x=0.8$ sintered at 400°C . The other values of (ΔS_M^{max}) and RCP recorded so far for various x compositions and hence the sintering temperatures were found to $x=0.4(400^\circ\text{C})$: 8.67 J/kg-K-1 and 155.25 J/kg-1 , $x=0.9 (200^\circ\text{C})$: 1.71 J/kg-K-1 and 50.8 J/kg , $x=1 (200^\circ\text{C})$: 3.17 J/kg-K-1 and 58.18 J/kg , and $x=1 (400^\circ\text{C})$: 15.03 J/kg-K-1 and 140.95 J/kg , respectively. Moreover, while considering the magnetic state exponent (n) values, the compositional variation along with sintering temperatures resembled various different models.

* Department of Physics, Comilla University, Cumilla,

1.9 Polybenzoxazine/ $\text{Co}_x\text{Mg}_{1-x}\text{Fe}_2\text{O}_4$ Nano Ferrite Composites: Synthesis, Identification and Optical Properties

S. Manjura Hoque, F.M. Kamal, S. I. Liba, M. R. Hasan, A. Kumar, A. Parveen, A. A. Begum, K. H. Fakir, N. Begum, N. Islam, A. Ghosh*

Nano-ferrites of chemical composition: $\text{Co}_x\text{Mg}_{1-x}\text{Fe}_2\text{O}_4$ where $x=0.0-0.4$, have been prepared by using two chemical methods to obtain the pure desired compositions without undesired phases. Benzoxazine monomer (BZ) has been synthesized using aniline, paraformaldehyde and phenol through Mannich condensation reaction followed by thermal curing to produce a pristine polymer. Specified weights of ferrite have been mixed with the monomer followed by thermal treatment to obtain the compositions. The X-ray diffraction (XRD) and Fourier transform infrared (FTIR) analysis have been used to ensure the formation of the desired ferrites, BZ, polybenzoxazine (PBZ) and/or composites. The XRD has been used also to determine some of the structural properties of the prepared ferrites. Furthermore, the average particle size of the ferrite samples has been calculated from the XRD patterns and it has ranged from 2.3 to 6.2 nm which is in fair agreement with the calculated average particle size from the transmission electron microscope (TEM) images (6.5 nm). For investigating the optical properties of the samples, UV-Vis spectroscopy has been measured. The band gap energy of the composites seem to decrease with increase in Cobalt concentration and it remained almost unaffected by the polymer matrix. The composites under investigation may be used in interesting device applications and coatings.

* Dept .of Applied Materials and Metallurgical Engineering, Bangladesh University of Engineering and Technology

1.10 Synthesis of Urea-Hydroxyapatite Fertilizer and Examining Its Efficiency in Boro Rice Cultivation

S. Manjura Hoque, F.M. Kamal, S. I. Liba, M. R. Hasan, A. Kumar, A. Parveen, A. A. Begum, K. H. Fakir, N. Begum, N. Islam, M. A, Al Asif *

Although nanotechnology is widely employed in electronics, medicine and energy storage systems, there has not been much effort to combine this expertise with agricultural research. The application of nanoscience in agriculture can help resolve the problem of modern agriculture confronting environmental hazards owing to the excessive use of synthetic fertilizers. A comparative study of the effects of urea-hydroxyapatite (urea-HAP) nanohybrids and urea on rice cultivation was conducted. The research focused on the synthesis of environmentally friendly HAP nanoparticles that would release nitrogen from urea in a controlled manner due to the strong bonding between particle and urea molecule. Maintaining 5:1 ratio of urea to HAP by weight, nanohybrids were synthesized using the chemical co-precipitation method, giving them distinct characteristics that were proven novel and important in the fields of nanoscience and agriscience. The urea-HAP, characterized by XRD, FTIR, TG/DTA and STEM-HADDF, confirmed the nanostructure formation and chemical composition of synthesized materials like crystal structure molecular makeup and nanoscale morphology.

* Dept. of Soil Science, Bangladesh Agricultural University, Mymensingh

1.11. Synthesizing of Activated Carbon Fiber Precursor from Jute Fiber

S. Manjura Hoque, H. N. Das, S. I. Liba, A. Nahar, A. Parveen, A. A. Begum, K. H. Fakir, N. Begum, Md. Shahabul Hossen *

Activated carbon fiber is a carbonaceous materials with a porous structure that has a tremendous scope of application in different fields. In this work activated carbon was synthesized from eco-friendly, renewable and ubiquitous jute fiber. Raw jute and NaOH treated jute were pyrolyzed at 500°C for 1 hr with N₂ gas. The carbonized carbon was activated with H₃PO₄ and KOH and again pyrolyzed at 650°C for 1 hr. The different features of activated carbons were characterized with Field Emission Scanning Electron Microscope , Energy Dispersive X-ray spectroscopy, Transmission Electron Microscope, X-ray Diffraction Analyzer and Thermogravimetric Analyzer. It was observed that KOH activated carbon exhibited a more porous structure than H₃PO₄ activated carbon. The EDX analysis showed that H₃PO₄ activated carbons had more than 90% carbon atoms indicating high level of carbon content. The TEM images revealed that activated carbon particles are in the nanoscale range. The average particle size of H₃PO₄ activated carbon and KOH activated carbon was 36.38 nm and 32.8 nm respectively. It was observed that activated carbon showed much higher thermal resistance than the jute fiber. The H₃PO₄ activated carbon obtained from NaOH–treated jute remained 84 % at 500°C. A higher thermal resistance was achieved with H₃PO₄ activated carbon since it contains 0.56% phosphorus. It was found that a higher carbon yield was obtained from NaOH treated Jute. The porous structure of the material showed that it could be used as an adsorbent and it is recommended for flame retardants and heat insulation application

* Dept. of Textile Engineering, Mawlana Bhashani Science and Technology University Engineering, University of Dhaka

1.12 Synthesis and Characterization of Cu-Gd Co-Substituted M-type SrFe₁₂O₁₉ Nanopowder Prepared by Sol-Gel Route

M. M. Haque, S. Manjura. Hoque, S. I. Liba, R. Rashid, M.R. Hasan, A. Nahar, A. Kumar, A. Parveen, A. A. Begum, K. H. Fakir, N. Begum, Z. Begum, M. R. Islam*

Hard magnetic Sr_{0.95} Gd_{0.05} Fe_{12-x} Cu_xO₁₉ (x=0.30, 0.60, 0.90) nanoparticles have been synthesized by the sol-gel method. Structural, magnetic and dielectric properties investigated through TGA, DTA, FTIR, XRD, TEM, EDS, PPMS, Impedance Analyzer, and UV spectroscopy. The phase formation of the hexaferrite confirmed through TGA and DTA analysis. The FTIR spectroscopy analysis and the ZRD study confirmed the formation of the M-type hexagonal structure of Sr_{0.95} Gd_{0.05} Fe_{12-x} Cu_xO₁₉. The lattice constants obtained

from XRD data are found in the ranges of (22.054-22.429) Å and (5.867-5.876) Å respectively. The ratio of lattice parameters is found in the range of 3.757 to 3.823 which exhibited the formation of an M-type hexaferrite structure. The average crystal size for $\text{Sr}_{0.95}\text{Gd}_{0.05}\text{Fe}_{12-x}\text{Cu}_x\text{O}_{19}$ ($x=0.3, 0.6, 0.9$) increases from 29.22 to 32.61 nm. TEM analysis show the particle size distribution is in the range of 55 to 75 nm. The room temperature hysteresis curve shows transition from hard to the typical soft ferromagnetic ($H_c = 5335.132$ to 1459.188 Oe) behavior of the sample. For $\text{Sr}_{0.95}\text{Gd}_{0.05}\text{Fe}_{12-x}\text{Cu}_x\text{O}_{19}$ ($x=0.3, 0.6, 0.9$), saturation magnetization (M_s) increases from 0.28 to 0.97 emu/gm, and coercivity (H_c) decreases from 5335 to 1459.18 Oe. The AC conductivity rises with increasing frequency for Cu-substituted $\text{Sr}_{0.95}\text{Gd}_{0.05}\text{Fe}_{12-x}\text{Cu}_x\text{O}_{19}$ NPs. Information on the charge conduction behavior of nanocrystalline materials is provided via the Cole-Cole plot. The transmittance, reflectance, Photon energy, refractive index, absorption coefficient, extinction constant, and real and imaginary parts of the dielectric constant were measured by UV spectroscopy.

* Department of Physics, Hajee Mohammad Danesh Science and Technology, University of Dinajpur, Dinajpur

1.13 Post Transition Metal Oxides Bi_2MoO_6 and Bi_2CrO_6 for Photocatalytic Applications

M. N. I Khan, S. Manjura Hoque, H. N. Das, S. I. Liba, A. Nahar, A. Parveen, A. A. Begum, K. H. Fakir, N. Begum, S. Sarwar *

Here we synthesized orthorhombic phase pure (JCPDS 21-0102, space group $\text{Pca}2_1$) Bismuth Molybdate Bi_2MoO_6 (BMO) in solvo-hydrothermal (pH-7) and Hydrothermal (pH-9) methods. The phase purity has been confirmed from Rietveld refinement of powdered XRD data with goodness of fitting value of 2.31 and 1.88. The desired Raman peaks of the orthorhombic BMO phase are detected in room temperature Raman measurements. The relevant chemical bond vibrations are detected in room temperature Raman measurements. The relevant chemical bond vibrations are detected in infrared spectroscopy. The field emission scanning electron micrograph revealed agglomerated nanoparticles with average size of 45 nm and random rectangular pellet-like shaped structures with ~75 nm size in pH-7 and pH-9 samples, respectively. The X-ray Photoelectron Spectroscopy confirmed the chemical oxidation states to be +3, +5 and -2 for Bi, Mo and O respectively. The detailed properties are analyzed in terms of complex dielectric constants for different functional. The photocatalytic dye degradation of Methylene Blue dye was evaluated to be 0.00184 and 0.00548 min^{-1} from UV-vis absorption measurements.

* Dept. of Electrical and Electronic Engineering, University of Dhaka

1.14 An Experimental Look into photocatalytic-Bismuth Molybdate

M. N.I. Khan, H. N. Das, R. Rashid, M. R. Hasan, A. Parveen, A. A. Begum, K. H. Fakir, A. Hossain, Z. Begum, N. Begum. S. Sultana*

Semiconductor materials are widely utilized as photocatalysts for the degradation of chemical dyes. In recent times, the Bismuth Molybdate (Bi_2MoO_6) has shown promising photocatalytic activity. Out of its three polymorphs, namely $\alpha\text{-Bi}_2\text{Mo}_3\text{O}_{12}$, $\beta\text{-Bi}_2\text{Mo}_2\text{O}_9$ and $\gamma\text{-Bi}_2\text{Mo}_6$, the $\gamma\text{-Bi}_2\text{Mo}_6$ has the most prominent photocatalytic reactivity with space group $\text{Pca}2_1$. Here we synthesized $\gamma\text{-Bi}_2\text{Mo}_6$ from two different precursors, Sodium Molybdate Dihydrate $(\text{NH}_4)_6\text{Mo}_7\text{O}_{24} \cdot 4\text{H}_2\text{O}$ (Sample C), and Ammonium Heptamolybdate Tetrahydrate, $(\text{NH}_4)_6\text{Mo}_7\text{O}_{24} \cdot 4\text{H}_2\text{O}$ (Sample D). The phase purity of the powdered samples were confirmed from Rietveld refinement of X-ray diffraction data χ^2 values of 2.31 for Sample C and 1.88 for Sample D. Strong absorption bands were found at 885 cm^{-1} and 890 cm^{-1} in the Raman spectra for the two produced samples, which indicates that there exists within the structure an orthogonal distortion of MoO_6 and thereby verifies the formation of the low-temperature phase of $\gamma\text{-Bi}_2\text{Mo}_6$. Additionally, characteristic absorption bands were detected for both samples from the FTIR absorption spectra at 839 and 792 cm^{-1} for Sample C and at 840, and 792 cm^{-1} for Sample D which occurs due to the symmetric and asymmetric stretching of MoO_6 octahedrons.

Dept. of Electrical and Electronic Engineering, University of Dhaka

1.15 Study on Cobalt and Zinc Doped Manganese Ferrite With Yttrium Substitution on Enhance the Electric, Magnetic and Optical Properties

M. N. I. Khan, S.Manjura Hoque, F. M. Kamal, H. N. Das, R. Rashid, M. R. Hasan, A. Parveen, K.H. Fakir, A. Hossain, N. Begum, Z. Begum, M. H. Rahman*

In this work rare earth element Yttrium substitute Co-Mn-Zn ferrite ($\text{Co}_{0.3}\text{Mn}_{0.2}\text{Zn}_{0.5}\text{Y}_x\text{Fe}_{2-x}\text{O}_4$) with $x=0.00, 0.01, 0.02, 0.03, 0.04, 0.05$ to investigate the possibility of enhancement of the structural, optical, electrical and magnetic properties. The materials were synthesized by solid state reaction method and sintered at 1150°C for 3 hours. The X-ray Diffraction patterns confirmed the single phase spinel structure of Co-Mn-Zn ferrite. The dielectric constant increases with increasing yttrium contents but decreases with increased frequency and remain almost constant at higher frequency range. The Saturation magnetization, coercivity and remanent induction have been calculated from M-H curve at room temperature. The maximum saturation magnetization observed at 101.68 emu/mg for $x=0.03$, which may be due to the transfer of Fe^{3+} ions from B-site to the A-site.

*Dept.of Physics, University of Barisal

1.16 Synthesis and Study of Structural, Electrical, and Magnetic Properties of Cobalt-Doped Bismuth Europium Manganese Ferrite

M. N. I. Khan, S.Manjura Hoque, F. M. Kamal, H. N. Das, R. Rashid, M. R. Hasan, A. Parveen, A. A. Begum, K.H. Fakir, A. Hossain, N. Begum, Z. Begum, F. Khanam*

Polycrystalline $\text{Bi}_{0.99}\text{Eu}_{0.01}\text{Fe}_{0.99-x}\text{Co}_x\text{Mn}_{0.01}\text{O}_3$ (BEFCMO) with $x=0.00, 0.01, 0.05, 0.10$ and 0.15 were synthesized using the solid-state reaction method. The X-Ray Diffraction (XRD) patterns unveiled a deformed rhombohedral perovskite structure, which is classified under the $R3c$ space group. Significantly, it was observed that when the cobalt doping level reached 15%, the (104) and (110) peaks exhibited a partial merging phenomenon. The Goldschmidt's tolerance factor, (0.8408 to 0.8499), suggests that the doped compound exhibits higher stability compared to the undoped compound. By employing the Scherrer equation, the size of the crystallites was calculated to be within the range of 48-29 nm, which agrees with the findings from Transmission Electron Microscopy (TEM). The d-spacing values obtained from the Selectron Diffraction (SAED) patterns were successfully matched with the XRD data which confirms the precise alignment of crystallographic planes (104), (024) and (220). The Energy Dispersive Spectroscopy (EDS) analysis verified the existence of key components (Eu, Bi, Mn, Fe and Co). The Fourier Transform Infrared (FTIR) spectra revealed prominent vibrational modes ($400\text{-}1000\text{ cm}^{-1}$) associated with the stretching of metal-oxygen bonds, notably Fe-O, BiO and Mn-O bonds.

* Department of Physics, University of Comilla, Cumilla

1.17 Investigating Structural, Optical Electrical, and Magnetic Properties of Chromium-Doped Lanthanum Cerium Bismuth Ferrite

M. N. I. Khan, S.Manjura Hoque, F. M. Kamal, H. N. Das, R. Rashid, M. R. Hasan, A. Parveen, A. A. Begum, K. H. Fakir, A. Hossain, Z. Begum, N. Begum, J. H. Bhuiyan

A typical solid-state reaction approach to synthesize a new ceramic materials called Polycrystalline $\text{Bi}_{0.9}\text{La}_{0.75}\text{Ce}_{0.025}\text{Fe}_{1-x}\text{Cr}_x\text{O}_3$ (Cr-doped LCBF) ($0.00 \leq x \leq 0.10$). The purpose of this synthesis was to investigate how modifying the structure of the material affects its magnetic, electrical and optical properties. Goldschmidt's tolerance factor of the samples was determined to range from 0.8422 to 0.8435, indicating a higher level of stability in doped LCBF compared to the parent LCBF. Rietveld refinement of the X-ray Diffraction patterns indicates a change in crystal symmetry from rhombohedral to orthorhombic when the concentration of Cr in the sample increases. Using the Scherrer equation, X-ray Diffraction analysis indicates increased crystallite size up to 3 % Cr concentration (max: 64.29 nm at $x=0.03$), followed by a decline with higher doping. This result obtained from the XRD examination is highly consistent with the analysis conducted using Transmission Electron Microscopy. The density drops progressively as the concentration of Cr increases and the highest bulk density ($\rho_B=5.09\text{ g/cm}^3$). The TEM observation can be explained by the existence of secondary or mixed-phase development, which is supported by the analysis of XRD and Rietveld refinement. The EDS findings validate the existence of crucial components La, Ce, Bi, Fe and Cr in the samples, ensuring the integrity and composition of both pure LCBF and Cr-doped LCBF. The FTIR results

verified the elongation vibrations of Fe-O and Bi-O bonds. UV-Vis spectroscopy was employed to determine the band gap energy of the synthesized nanoparticles.

* Department of Physics, University of Comilla, Cumilla

1.18 Synthesis, Characterization, and Photodegradation Performance of BiPO₄ Polymorphs

M. N. I. Khan, S. Manjura Hoque, H. N. Das, R. Rashid, M. R. Hasan, A. Parveen, A. A. Begum, K. H. Fakir, A. Hossain, Z. Begum, N. Begum, M.R. Haq & N. Ehasn

This project involves the concurrent study of two materials: bismuth phosphate (BiPO₄ and Bismuth Vanadate BiVO₄). The experimental phase for BiPO₄ was conducted last semester. In the Current semester, we focused on the theoretical analysis of the inherent properties of two BiPO₄ phases, hexagonal (HBPO) and monoclinic (MBPO), Utilizing first-principles Density Functional Theory (DFT). We show that relativistic spin orbit corrections (SOC) on top of hybrid density functional Heyd-Scuseria-Ernzerhof (HSE06) accurately model the experimental 3.90 eV (HBPO) electronic band gaps along with their indirect nature measured from diffuse reflectance spectroscopy. Raman peaks measured at room temperature are detected in Raman tensor simulations. The dynamical and mechanical stabilities of HBPO and MBPO were conformed from phonon and elastic tensor simulations, respectively. Concerning our second material undoped BiVO₄ and (Gd, Mo) co-doped Bi_{1-x}Gd_xV_{1-y}Mo_yO₄ samples were hydrothermally synthesized for x=0.02, 0.04, 0.06, 0.08 and 0.10. The co-doped Bi_{1-x}Gd_xV_{1-y}Mo_yO₄ samples revealed mixed monoclinic scheelite (ms) and tetragonal zircon (tz) in Rietveld refinements of X-ray diffraction (XRD) data. Raman spectroscopy indicated prominent peaks at ~811 cm⁻¹ for ms-dominant samples and ~855 cm⁻¹ for tz-dominant samples.

* Department of Electrical and Electronic Engineering, University of Dhaka

1.19 Investigation of Structural, Electrical, and Magnetic Properties of the Cobalt, Zinc, and Manganese-Doped Ferrite with Gadolinium Substitution

M. N. I. Khan, S. Manjura Hoque, H. N. Das, R. Rashid, M. R. Hasan, A. Parveen, A. A. Begum, K. H. Fakir, A. Hossain, Z. Begum, N. Begum, J. Mounsi*

Manganese ferrite is a promising material for various applications due to its high magnetization and electrical conductivity. In the mixed spinel structure of MnFe₂O₄ the metal cations Mn²⁺ and Fe³⁺ are attached at A- (tetrahedral) and B- (Octahedral) sites respectively. Various dopants in the A- and B-site of the MnFe₂O₄ have been used to enhance the electric and magnetic properties for several applications. It is investigated the structural properties of Co_{0.3}Mn_{0.2}Zn_{0.5}Gd_xFe_{2-x}O₄, with 0.00, 0.03, 0.05, 0.07, 0.10 where Zn and Co-doped with Mn²⁺ in the A-site and Gd³⁺ are substituted Fe³⁺ partially in the B-site. The XRD was performed to investigate the structural properties and found that the sharp Bragg peaks match with standard pattern JCPDS (10-0319) of MnFe₂O₄ indicating the formation of a single-phase cubic spinel structure. The lattice parameter increases with increasing Gd contents up to x=0.05 and then decreases with increasing Gd contents. This increase and decrease of lattice parameters occur due to the distortion of the spinel lattice structure. The maximum X-ray density found was 5.254 gcm⁻³ for x=10% Gd while x=0% has the lowest X-ray density of 5.029 gcm⁻³. The minimum porosity was calculated to be 31.7% for a Gd content of 3%. The infrared spectroscopy of the Co_{0.3}Mn_{0.2}Zn_{0.5}Gd_xFe_{2-x}O₄ ferrites samples was carried out to investigate the structural behavior and identify the chemical bounds. It was observed two characteristic absorption bands ν_A centering around 536 cm⁻¹ and ν_B centering around 386cm⁻¹.

* Department of Physics, University of Barishal, Barishal

1.20 Comparative Study of Structural, Thermoluminescence and Kinetic Properties of Ce- Doped and Undoped LiZnBO₃ for Dosimetry Application

M. Al-Mamun, S. Manjura Hoque, M. N. I. Khan, H. N. Das, R. Rashid, M. R. Hasan, A. Parveen, A. A. Begum, K. H. Fakir, A. Hossain, Z. Begum, N. Begum, S. A. Islam*

Although different lanthanum has been used in phosphor LiZnBO₃ (LZB) as dopants but utilizing less expensive Ce in borate glass is a newer area of inquiry as a TLD material. The phosphor LiZnBO₃ (LZB) doped with Ce was synthesized and characterized in this relatively recent work and the structural analysis and TL characterization yielded results that were quite satisfactory. The solid-state reaction process was used to

prepare the doped sample with weight % doping computation method was used. The structural and TL properties of undoped LiZnBO_3 and Ce doped $\text{LiZnBO}_3\text{:Ce}$ (LZB:Ce:Ce) were characterized by the same techniques and the samples investigation through XRD and FTIR measurement data provides distinct peak positions that can be used to describe an atom's bond and mode of vibration inside a crystal structure. Doping impurities, atoms or molecules alters the host material's structure and dilutes the concentration of functional groups responsible for the peak and structure and dilutes the concentration of functional groups responsible for the peak and intensity of the doped FTIR spectrum.

* Department of Physics, Begum Rokeya University, Rangpur

1.21 Operating Atomic Absorption Spectrophotometer (AAS)

M. Al-Mamun, S. Manjura. Hoque, S. I. Liba, R. Rashid, M.R. Hasan, A. Nahar, A. Kumar, A. Parveen, A. A. Begum, K. H. Fakir, N. Begum, Z. Begum, T. T. Nokrek *

The work is aimed to develop proficiency in operating the flame AAS instrument and establish standard calibration curves for quantifying Cr, Cd and Pb in various samples, including vegetables, soil, sediment, water and hyacinth. Standard solutions were prepared from stock solutions and absorbance values were measured to generate calibration curves. AAS operates on the principle of element-specific light absorption in the gas phase, with quantification achieved by comparing sample absorption to standards. The instrument comprises several components including HCL, monochromator, detector, atomizer & nebulizer. Human errors, such as mislabeling and incorrect sample handling, were identified as potential sources of error and were mitigated through proper labeling and careful handling procedures. Overall, the internship provided valuable experience in AAS operation and analytical techniques.

* Department of Nutrition and Food Engineering, Daffodil International University

1.22 Interplay Between Ferroelectric and Ferromagnetic Phases of Mn Substituted of Multiferroic $\text{Bi}_{0.8}\text{Sm}_{0.1}\text{Dy}_{0.1}\text{Fe}_{1-x}\text{Mn}_x\text{O}_3$ Ceramics

M.R. Hasan, S. Manjura. Hoque, M. N. I. Khan, S. I. Liba, R. Rashid, A. Nahar, A. Kumar, A. Parveen, A. A. Begum, K. H. Fakir, N. Begum, Z. Begum, M. A. Mimi *

Various multiferroic $\text{Bi}_{0.8}\text{Sm}_{0.1}\text{Dy}_{0.1}\text{Fe}_{1-x}\text{Mn}_x\text{O}_3$ ($x=0.00, 0.01, 0.03$ and 0.05) ceramics have been synthesized by the standard solid-state reaction technique and calcined at 700°C for 5 h. The structural, microstructural, complex initial permeability, initial permeability, dielectric properties, electric modulus, impedance spectroscopy and ac conductivity of the samples have been investigated thoroughly. X-ray diffraction analysis ensured that all samples are formed distorted rhombohedral perovskite structure. Microstructural and quantitative analysis are performed by field Emission Scanning Electron Microscope and Energy Dispersive X-ray Spectroscopy respectively. The bulk density and theoretical density decreases with increasing Mn content. The initial permeability of the samples increased with the increasing of Mn contents due to increasing grain diameter. It is also found that the value of RQF increases with the increase in Mn content. The peak corresponding to maxima in RFQ shifts toward the lower frequency region Mn content which is the consequence of Snoek's relation. Due to space charge polarization dielectric dispersion is observed. This phenomenon can be explained by the Maxwell-Wagner model. The value of real part of electric modulus is found very low at lower frequencies and it increases with the increase in frequency. This continuous dispersion on increasing frequency may be contributed to the conductivity measurements, it is observed that the AC conductivity increases with increasing frequency due to small polaron hopping which can be explained according to Jonscher's power law.

* Department of Physics, Jagannath University, Dhaka

2. Oral/Poster Presentation in Seminar/Symposium/Conference (National and International)

Name of the Participant	Title of Oral/poster presentation	Title of the event	Organizer	Date	Place
S. Manjura Hoque	Correlation of composition and particle size on magnetic relaxation and their effects on hyperthermia	8 th Conference of Bangladesh Crystallographic Association	Bangladesh Crystallographic Association	24-25 November 2023	Department of Physics, University of Dhaka

M.A. Rahman, J. Popper, H.N. Das	Growth of semiorganic L-asparagine monohydrate doped ammonium dihydrogen phosphate crystals and characterization of structural, optical, thermal, electrical and mechanical properties for nonlinear optical applications	8 th Conference of Bangladesh Crystallographic Association	Bangladesh Crystallographic Association	24-25 November 2023	Department of Physics, University of Dhaka
N.Jahan, J.I. Khandaker, H.N. Das and M.N.I.Khan	Structural, Electrical and Magnetic Properties of the Al ³⁺ substituting in Ni-Zn-co Nano-spinel Ferrites for Electronic Devices	International Conference on Electronics and Informatics 2022	Bangladesh Electronics Society	26-28 January, 2023	Atomic Energy Centre, Dhaka
F. Ahammed, M.A.H. Badhan, M.S. Ullah, R. N. Sajjad, S. Manjura Hoque, M.N.I. Khan, and A.T.M. K. Jamil	Structural, Elastic and Magnetic Properties of Li-Cu-Mn-Zn Mixed Ferrites	8 th Conference of Bangladesh Crystallographic Association	Bangladesh Crystallographic Association	24-25 November, 2023	Department of Physics, University of Dhaka
M A. Rahman, H.A. Simol, M.S. Islam, R. A. Jahan, T. Debnath, R. Rashid, P. K. Bakshi	Synthesis and characterization of Mixed Metal Tungsten Bronzoid	8 th Conference of Bangladesh Crystallographic Association	Bangladesh Crystallographic Association	24-25 November, 2023	Department of Physics, University of Dhaka
S. Manjura Hoque	Effect of Bi ₂ O ₃ as a sintering aid on the magnetic properties of Mg-Cu-Zn ferrites	1st National Conference on Advances in Science and Technology		7 - 8 December, 2023	Faculty of Science, BUET
Mohammad Nazrul Islam Khan	Nanotechnology: Perspective and research scope	Golden jubilee Celebration BCSIR CONGRESS-2023	BCSIR	08-10 March 2024	Institute of Bioequivalence studies and Pharmaceutical Sciences
Fatema Tuz Zohora Toma	Optimizing the structural and elemental properties of chemically precipitated CdS nanoparticles through controlled annealing for advanced applications	Golden jubilee Celebration BCSIR CONGRESS-2023	BCSIR	08-10 March 2024	Institute of Bioequivalence studies and Pharmaceutical Sciences
S. Manjura Haque	Exceedingly small polymer-oxide nanohybrid as TOF 3D magnetic resonance angiography contrast agent	Golden jubilee Celebration BCSIR CONGRESS-2023	BCSIR	08-10 March 2024	Institute of Bioequivalence studies and Pharmaceutical Sciences
F. J. Antee, R. Rahman, A. Anwar, I. N. Esha, S. Manjura Hoque, M. N. I. Khan, M. S. Bashir, K. H. Maria	Modifying the Multiferroic Characteristics of Composites Consisting of (1-x) Ba _{0.6} Sr _{0.4} Cr _{0.6} Ti _{0.4} O ₃ + (x)CoFe _{1.8} La _{0.2} O ₄ Prepared via the Double Sintering Ceramic Method	International Conference on Physics -2024	Bangladesh Physical Society	9 – 11 May 2024	Atomic Energy Centre, Dhaka

S. K. Joshi, R. P. Dhakal, R. Adhikari	Investigation of Castor Oil as a Base Stock for Green Lubricant	International Conference on Physics -2024	Bangladesh Physical Society	9 – 11 May 2024	Atomic Energy Centre, Dhaka
R. S. Auntu, M. M. A. Khan, S. K. Shil, S. S. Sikder, M.N.I. Khan, R. Rashid	Study of Magnetic Properties of SolidState Method Synthesized $\text{Ni}_{0.65}\text{Cu}_{0.15}\text{Zn}_{0.20}\text{Fe}_{1.96}\text{Cr}_{0.04}\text{O}_4$ Ferrites and Optimization of Sintering Temperature	International Conference on Physics -2024	Bangladesh Physical Society	9 – 11 May 2024	Atomic Energy Centre, Dhaka
M.H. Rahman, M. N. I. Khan, R. Rashid, A. Kumar, H. N. Das, M. K. Alam and M. M. Alam	Effect of Rare Earth Element to Enhance the Magnetic Properties of Ferrite	International Conference on Physics -2024	Bangladesh Physical Society	9 – 11 May 2024	Atomic Energy Centre, Dhaka
M. N. Uddin, S. Alam, H. Das	Synthesis and Optimization of Cubic Shaped Magnetite Nanoparticles by One-Step Ultrasound Irradiation Process	International Conference on Physics -2024	Bangladesh Physical Society	9 – 11 May 2024	Atomic Energy Centre, Dhaka
M.A.G. Osman, F. Chowdhury, H.N. Das, K. H. Maria	Hydrothermal Synthesis of Fe-Doped Tin Disulfide Nanoparticles for Highly Efficient Visible Light Photocatalysis	International Conference on Physics -2024	Bangladesh Physical Society	9 – 11 May 2024	Atomic Energy Centre, Dhaka
M.D. Hossain, M.A. Hossain, M.N.I. Khan, S.S. Sikder	Optimizing the Sintering Temperature Effect of Ni Nano Ferrite for High Frequency Applications	International Conference on Physics -2024	Bangladesh Physical Society	9 – 11 May 2024	Atomic Energy Centre, Dhaka
J. H. Bhuiyan, A. Ahad, M.A. Taher, R. Rashid, A. Kumar, M. R. Hassan, M. S. Hossain, T. Ahamed, F. Khanam, M.N.I. Khan	Investigating Structural, Optical, and Magnetic Properties of Chromium-doped Lanthanum Cerium Bismuth Ferrite	International Conference on Physics -2024	Bangladesh Physical Society	9 – 11 May 2024	Atomic Energy Centre, Dhaka
M.N. Rahman, M.A. Hossain, M.T.A. Sourav, S.K. Shil, S.S. Sikder, and M.N.I. Khan	Fabrication of Cobalt-Substituted Manganese Nano-ferrite via Chemical Co-precipitation Methodology for Prospective Biomedical Implementations	International Conference on Physics -2024	Bangladesh Physical Society	9 – 11 May 2024	Atomic Energy Centre, Dhaka
M. R. Haq, N. Ehsan, S. S. Nishat, Q. S. Hossain, M. N. I. Khan, M. S. Bashar, U. S. Akhtar, F. Chowdhury, S. Jahan, K. S. Hossain, M. M. Khan, S. M. S. Imran, and I. Ahmed	Comprehensive First-Principles Modeling of Experimentally Synthesized BiPO_4 Polymorphs	International Conference on Physics -2024	Bangladesh Physical Society	9 – 11 May 2024	Atomic Energy Centre, Dhaka
S. S. Sarna, S.	A Comprehensive Study on	International	Bangladesh	9 – 11	Atomic Energy

Alam, H. Das	the Synthesis and Characterization of Spherical Silver Nanoparticles via Ultrasonic Irradiation	Conference on Physics -2024	Physical Society	May 2024	Centre, Dhaka
M. Ohiduzzaman, M. N. I. Khan, K. A. Khan	Garlic Extract Mediated Biosynthesis of Silver Nanoparticles: Characterizations, Antibacterial Activity, and Bioelectricity Generation	International Conference on Physics -2024	Bangladesh Physical Society	9 – 11 May 2024	Atomic Energy Centre, Dhaka
M. R. Islam, S. K. Sen, A. Kumar, M. S. Manir	Annealing Temperature Variation on Structural and Optical Properties of CuO Nanoparticles Green Synthesized using <i>Mussaenda frondosa</i> Leaves	International Conference on Physics -2024	Bangladesh Physical Society	9 – 11 May 2024	Atomic Energy Centre, Dhaka
M. Z. Hasan, M. M. Hossain, M. A. Ali, N. I. Khan and M. M. Uddin,	Efficient MXenes Photocatalysts for The Organic Dye Degradation Under UV and Solar Light Synthesized by Etching Technique	International Conference on Physics -2024	Bangladesh Physical Society	9 – 11 May 2024	Atomic Energy Centre, Dhaka
S. Saroar, S. Sultana, S. S. Nishat, Q. S. Hossain, M. N. I. Khan, D. Islam, U. S. Akhtar, M. S. Bashar, S. Jahan, K. S. Hossain, and I. Ahmed	Ab initio Density Functional Perspectives on Experimentally Synthesized γ -Bi ₂ MoO ₆	International Conference on Physics -2024	Bangladesh Physical Society	9 – 11 May 2024	Atomic Energy Centre, Dhaka
M. Al-Amin, M. H. Ullah, M. K. Alam, M. J. Rahman M.N.I. Khan	Mechanical and Thermal Properties of Reduced Graphene Oxide Reinforced Polypropylene/Banana Midrib Fibre Nanocomposites	International Conference on Physics -2024	Bangladesh Physical Society	9 – 11 May 2024	Atomic Energy Centre, Dhaka
M. Ohiduzzaman, M.N.I. Khan, K.A. Khan, B. Paul	Crytallographic Insights: Synthesis of Silver Nanoparticles using Banana Pulp Extract and Nanoscale Chracterization Techniques	International Conference on Physics -2024	Bangladesh Physical Society	9 – 11 May 2024	Atomic Energy Centre, Dhaka
M. R. Islam, S.K. Sen, A. Kumar, M.S. Monir, P. Pas	Green Synthesis of Zinc Oxide (ZnO) Nanoparticles using Syngonium Leaves and its Characterizations	International Conference on Physics -2024	Bangladesh Physical Society	9 – 11 May 2024	Atomic Energy Centre, Dhaka
M.S. Al-Rafi, M.S.S. Das, M. N. I. Khan, D. Islam, U.S. Hossain, A.Hossain	Mineralogical and elemental Studies of Rock samples Collected from Bisnakandi of Sylhet	International Conference on Physics -2024	Bangladesh Physical Society	9 – 11 May 2024	Atomic Energy Centre, Dhaka
M. Begum, R. Khan, S.M.M. Al Mamunand S. M. Hossain,	Radiation Hazard Indices Assessment for Core Samples of Rashidpur and Koilastila Gas Fields of Bangladesh	International Conference on Physics -2024	Bangladesh Physical Society	9 – 11 May 2024	Atomic Energy Centre, Dhaka

S. Hossain, M. Al Mamun, S. Yesmin and A.K.M.M. Rahman	Smart Phone Glass Screen Protector : A Fortuitous Solution to Measure Radiation Doses in Case of Nuclear or Radiological Accident	International Conference on Physics -2024	Bangladesh Physical Society	9 – 11 May 2024	Atomic Energy Centre, Dhaka
I. Hossain, S.S. Rashid, M.M. Islam, R. Rashid, M.R. Hossain, H. M. Waliullah, M.M. Rana and M.N.I. Khan	Development, Properties and Investigation of Ultra Fine CoFe_2O_4 Nano Crystals Prepared by Modified Sol-Gel Route	International Conference on Physics -2024	Bangladesh Physical Society	9 – 11 May 2024	Atomic Energy Centre, Dhaka
M.A. Islam, M.N.I. Khan, R. Rashid, M.R. Hasan and M.M. Alam	Study of Gadolinium Effect of Cobalt and Zinc-Doped Manganese Ferrite	International Conference on Physics -2024	Bangladesh Physical Society	9 – 11 May 2024	Atomic Energy Centre, Dhaka
M.A. Islam, M.N.I. Khan, R. Rashid M.R. Hasan and M.M. Alam	Study the Properties of Zinc Doped Manganese Ferrite	International Conference on Physics -2024	Bangladesh Physical Society	9 – 11 May 2024	Atomic Energy Centre, Dhaka
S.S. Rashid, M.M. Islam, I. Hossain, M.R. Hasan, R. Rashid, H. M. Waliullah, M. Rana and M.N.I. Khan	Synthesis And Characterization of Nickel Ferrite Nanoparticles Sintered in Different Temperatures by Sol gel Auto Combustion Method	International Conference on Physics -2024	Bangladesh Physical Society	9 – 11 May 2024	Atomic Energy Centre, Dhaka
S. Sourav, S. Alam and H. Das	Ultra-Fast Microwave Irradiated Synthesis of Zinc Oxide Nanorods and Estimation of Their Structural, Morphological and Optical Properties	International Conference on Physics -2024	Bangladesh Physical Society	9 – 11 May 2024	Atomic Energy Centre, Dhaka
F. Khanam, M.A. Taher, A. Ahad, R. Rashid	Investigating Structural and Dielectric Properties of Cobalt Doped Bismuth Europium Manganese Ferrites	International Conference on Physics -2024	Bangladesh Physical Society	9 – 11 May 2024	Atomic Energy Centre, Dhaka
M.H. Rahman, M.N.I. Khan, R. Rashid, A. Kumar, H.N. Das, M.M. Alam	Effect of Rare Earth Element to Enhance the Magnetic Properties of Ferrite	International Conference on Physics -2024	Bangladesh Physical Society	9 – 11 May 2024	Atomic Energy Centre, Dhaka
P. Roy, K. Nahar, M.A. Hossain, S.S. Sikder and M.N.I. Khan	Sintering effect on dielectric and magnetic properties of La doped Cu-Zn ferrites prepared by Solid State Reaction Technique	International Conference on Physics -2024	Bangladesh Physical Society	9 – 11 May 2024	Atomic Energy Centre, Dhaka
M.D. Hossain, M.A. Hossain, M.N.I. Khan, S.S. Sikder	Finding the Best Performance of 3d Transition Metal (Mn, Co and Ni) Substituted Nano Ferrites for High Frequency	International Conference on Physics -2024	Bangladesh Physical Society	9 – 11 May 2024	Atomic Energy Centre, Dhaka

	Applications				
S. Hossain, T.I. Protik and M.G. Sazid	Potential Risk of Faking Microscopic Images in the Characterization of nanomaterials Through Artificial Intelligence	International Conference on Physics -2024	Bangladesh Physical Society	9 – 11 May 2024	Atomic Energy Centre, Dhaka
M. Rokonozzaman, N. Banik, M.A. Haque, M.K.Alam, K. Nandi, S. Ahmed, N.Begum, M.M.I. Khan R. Rashi	Synthesis and Chracterization of Hydroxyapatite-Iron oxide nanocomposites usin Ocimum sanctum leaf extract by hydrothermal method	International Conference on Physics -2024	Bangladesh Physical Society	9 – 11 May 2024	Atomic Energy Centre, Dhaka
M.F. Alam, M.A. Rahman, I.A. Khan, R. Rashid, and M.K. Alam	Varid Impact of Titanium Doping on Ni-Zn ferrite Nanoparticles: Evaluating Structural, Electrical, Optical and Magnetic Properties	International Conference on Physics -2024	Bangladesh Physical Society	9 – 11 May 2024	Atomic Energy Centre, Dhaka
S. Gazi, S.H. Munna, M.A. Hossain, M.S. Sikder, S.S.Sikder ans M.N.I. Khan	Impact of Sintering temperature on Ni-Mg nano ferrites prepared by Chemical co-precipitation method	International Conference on Physics -2024	Bangladesh Physical Society	9 – 11 May 2024	Atomic Energy Centre, Dhaka
M.W. Sadik, R. Jannat, M.A. Hossain, S.S. Sikder and M.N.I. Khan	“Influence of Au on structural dielectric and magnetic properties of Co based nano ferrite prepared Co precipitation Method	International Conference on Physics -2024	Bangladesh Physical Society	9 – 11 May 2024	Atomic Energy Centre, Dhaka
S.H. T. Zim, K.A. Rahman, M.A. Hossain, M.S. Sikder M.N.I. Khan and M.A. Hossain,	Structural dielectric and magnetic properties of Ag-Mg nanocomposites at different sintering temperature	International Conference on Physics -2024	Bangladesh Physical Society	9 – 11 May 2024	Atomic Energy Centre, Dhaka
M.S. Sakib, S. Sultana, M. N. Rahman, S. K. Shil, S.S. Sikder, M.N.I. Khan and M.A. Hossain	Exploring Thermo-Sensitive Dielectric and Magnetic Respones in Co-Ni Nano-ferrite	International Conference on Physics -2024	Bangladesh Physical Society	9 – 11 May 2024	Atomic Energy Centre, Dhaka
M.J. Hosen, M. Sharmin, J. Podder and H.N. Das	Study of structural, surface morphological, optical and electrical properties of Sol-gel deposited MnO ₂ /NiO thin films	International Conference on Physics -2024	Bangladesh Physical Society	9 – 11 May 2024	Atomic Energy Centre, Dhaka
J.H. BhuiyN, a. Ahad, M.A. Taher, R. Rashid, A. Kumar, M.R. Hassan, M. Sarwar Hossain, T. Ahmed, F. Khanam, M.N.I. Khan	Investigating Structural, Optical and Magnetic Properties of Cobalt Doped Bismuth Euroium Manganese Ferrite	International Conference on Physics -2024	Bangladesh Physical Society	9 – 11 May 2024	Atomic Energy Centre, Dhaka

F. Khanam, M.A. Taher, A. Ahad, R. Rashid, A. Kumar, M.R. Hasan, T. Ahmed, J. H. Bhuiyan, M.K. Alam, M.N.I. Khan	Investigating Structural and Dielectric Properties of Cobalt Doped Bismuth Europium Manganese Ferrites	International Conference on Physics -2024	Bangladesh Physical Society	9 – 11 May 2024	Atomic Energy Centre, Dhaka
S.H.T. Zim, K.A. Rahman, M.A. Hossain, M.S. Sikder, S.S. Sikder and M.N.I. Khan	Structural, dielectric and magnetic properties of Ag-Mg nanocomposites at different sintering temperature	International Conference on Physics -2024	Bangladesh Physical Society	9 – 11 May 2024	Atomic Energy Centre, Dhaka
M.A. Gafur, M.N.I. Khan, M.A. Hossain and S.S. Sikder	Influence of Zr ⁴⁺ substitution on structural, magnetic, dielectric and electrical properties of Co-Zn ferrites	International Conference on Physics -2024	Bangladesh Physical Society	9 – 11 May 2024	Atomic Energy Centre, Dhaka
M.A. Gafur, M.N.I. Khan, M.A. Hossain and S.S. Sikder	Zinc ferrite-enhanced magnetic resonance angiography in Rat model	International Conference on Physics -2024	Bangladesh Physical Society	9 – 11 May 2024	Atomic Energy Centre, Dhaka

Medical Physics Division, AECD

Objective

Medical Physics Division in Atomic Energy Centre, Dhaka was established in 2014. The prime objectives are:

- To develop qualified medical physics professionals by organizing training courses on the Medical Physics aspect.
- To provide medical physics expert services in hospitals all over the country to ensure quality cancer treatment.
- Commissioning, Setup, Calibration, Acceptance testing, QA/QC, research and development work in the field of medical physics.
- To facilitate research work leading to MS/ MPhil/ PhD degrees and post-doctoral research works with the affiliation of different Universities.

1. Research and Development Work

1.2 Assessment of Photon Beam Calculation Algorithm(AAA) Sensitivity to Metallic Implant Artifacts Using a CIRS Thorax Phantom

R. Khatun, S. Akter, A. N. Monika and M. Chowdhury*

The aim of this study was to evaluate the effect of metallic artifact on radiation dose calculations for patients with metallic implants and to find ways in reducing the errors associated with TPS dose calculation based on CT simulation. In this study, bone and standard algorithm of CT simulation gave reasonably good results. But in some cases unsatisfactory results were obtained. The AAA method of TPS is moderately appropriate for dose computation in heterogeneous media and regions of high density gradient (soft tissue, bone etc.) and metallic implant region when using the CIRS Thorax Phantom for external beam radiation. Due to scattering, the amount of extra CT value or HU value found in stainless steel suggests that the patient is receiving more of the dose than would be required if the patient had a metallic implant. Hence this study suggests that, in case of metallic implant in the patient's body, the dose should be administered with consideration for the possibility of unexpected dose received while optimizing dose delivery during treatment planning.

*Dept. of Medical Physics and Biomedical Engineering (MPBME), Gono Bishwabidyalay, Savar, Dhaka

1.2 Study of the R/OSL Properties of Various Sensors using Real-time RL OSL Dosimetry System

R. Khatun, S. Akter and A. N. Monika

This work aims to study the RL and OSL responses of various commercial/doping sensors using a myOSL reader based on optical fiber for an RLOSL dosimetry system that can advance both materials analysis and medical dosimetry applications by reducing the risks of data loss, contamination, and human error. Radioluminescence (RL) is a phenomenon that light is emitted simultaneously by the recombination of the pair-produced electron and hole in the recombination center when the material is exposed to radiation. This can be used in measuring radiation in real-time. Optically Stimulated Luminescence (OSL) is a phenomenon where certain materials emit light after being exposed to ionizing radiation and then stimulated by light of a specific wavelength. RL characteristics provide real-time information on dose rates, while OSL signals correlate with the cumulative dose absorbed by the material. This dual-mode measurement approach offers a comprehensive analysis of radiation exposure dynamics. Overall, RL OSL dosimeters play a crucial role in radiotherapy by providing precise measurements of both the total radiation dose and the instantaneous dose rate, thereby ensuring safe and effective treatment for patients while maintaining quality control in clinical settings. Research is ongoing using the RL OSL dosimetry system with PMMA optical communication fiber.

1.3 Dosimetric Evaluation of Computed Tomography (CT) Scanner using Computed Tomography Dose Index (CTDI) Phantom: For Adult Head Case

S. Akter, R. Khatun and A. N. Monika

The purpose of this study is to measure and compare the CTDI_{vol} of the Adult Head scan technique of CT machine using CTDI phantom. The study was executed in a 128-slice Ingenuity TF PET-CT Scanner using Adult Body CTDI phantom. The temperature was set as $T = 19.4^{\circ}\text{C}$, Pressure was set as 1014.2 kPa. The scanner was set at axial mode with current 100 mAs, scan length 10 mm, and collimation 16X0.625. The scan was taken by varying voltage. IBA pencil ionization chamber DCT10 was used to measure the dose at different positions inside the phantom and data were collected using IBA MagicMax Universal software. Report of AAPM Task Group 96 and 111 formalisms were used to determine dose estimation. For 100kV, 120 kV, and 140kV the experimental CTDI_{vol} was found as 9.7, 15.9, and 23.1 mGy respectively and Console CTDI_{vol} from the scanner was found as 9.72, 17.11, and 25.13 mGy respectively. By comparing the experimental with the machine data we observed that it was within the acceptable limit of $\pm 20\%$. For the optimization of radiation dose for various imaging protocols, CTDI phantom is a useful tool in CT dose management.

1.4 Small Field Dosimetry Study with Razor Diode in Radiotherapy

A. N. Monika, R. Khatun and S. Akter

In this study Percentage depth dose, Inline-beam profile, and Cross line-beam profile were analyzed. Source to surface distance (SSD) was 100 cm, and the dose rate was 400 MU/min, with this setup five sizes of the field were selected for this study i.e. $5 \times 5 \text{ cm}^2$, $4 \times 4 \text{ cm}^2$, $3 \times 3 \text{ cm}^2$, $2 \times 2 \text{ cm}^2$, and $1 \times 1 \text{ cm}^2$. 6 MV photon beam was used. A razor diode was used to irradiate inside the 3D water phantom (IBA Blue Phantom²) and the dose was measured with the help of an electrometer. All PDD graphs corresponded to all field sizes and showed a pick around 1.5 cm and gradually decreased with the increase of depth, which is the natural dose buildup point for a 6 MV photon beam. Inline and crossline graphs of five fields were also superimposed with each other- another agreement of field size symmetry. Though a small field started from $4 \times 4 \text{ cm}^2$ or less, the study continued with a one cm large field to observe response variation with sizes. When the smaller field of $1 \times 1 \text{ cm}^2$ is selected, scattering effects become more prominent which is normal as this linac machine has a 2 cm penumbra effect.

2. Manpower Development (Training/Fellowship /Workshop/Meeting)**2.1 Attend in Training/Fellowship/Workshop/Meeting:**

Sl. No.	Title of the program	Date	Place	Number of participants
1.	Workshop on Biophysics	28 June 2024	BUET	01

3. Oral/Poster Presentation in Seminar/Symposium/Conference (National and International)

Name of the Participants	Title of the oral/poster presentation	Title of the event	Organizer	Date	Place
Dr. Rajada Khatun	Quality Control of High Dose Rate Brachytherapy Treatment Facility in BSSMU	Bangladesh International Cancer Congress 2023	Oncology Club	14-15 September 2023	Radisson Blu Water Garden Hotel, Bangladesh
	Evaluation of Radiation Dose in Computed Tomography using CTDI Phantom	Interational Conference on Physics-2024	BPS	9-11 May 2024	AECD
Shirin Akter	Quality Control of High Dose Rate Brachytherapy Treatment Facility in BSSMU	Bangladesh International Cancer Congress 2023	Oncology Club	14-15 September 2023	Radisson Blu Water Garden Hotel, Bangladesh
	Evaluation of Radiation Dose in Computed Tomography using CTDI Phantom	Interational Conference on Physics-2024	BPS	9-11 May 2024	AECD
	Necessity of Photo-Neutron Dose Measurement From Medical Linear Accelerator in Radiotherapy	AECD Scientific Seminar	MPD, AECD	12 June 2024	AECD
Ashrafun Nahar Monika	Quality Contr of High Dose Rate Brachytherapy Treatment Facility in BSSMU	Bangladesh International Cancer Congress 2023	Oncology Club	14-15 September 2023	Radisson Blu Water Garden Hotel, Bangladesh
	Assessment of Solid Phantom's Compatibility with Water Phantom Using Photon Energy with a Depending Depth	Interational Conference on Physics-2024	BPS	9-11 May 2024	AECD
	Small Field Dosimetry Study with Razor Diode in Radiotherapy	AECD Scientific Seminar	MPD, AECD	12 June 2024	AECD

4. Collaboration Work/MOU (ADP/FNCA/MEXT/FTC/IAEA/RCA/TC/S&T/In-house project, Universities etc.)

- a) ADP Project: MPD, AECD gives up the necessary support of the Annual Development Project of the Ministry of Science of Technology (MOST) entitled the “Establishment of PET/CT & Cyclotron facility at INMAS Mymensingh and Chattogram and Cyclotron facility at Institute of Nuclear Medical Physics (INMP), Savar”, BAEC. (2018-2025)
- b) S & T Project: “Dosimetric Verification of Radiotherapy Treatment Planning System (RTPS) in Bangladesh - a National Audit”, SRG-236614, MOST. (2023-2024)

Non-Destructive Testing Division

Objective

Non-Destructive Testing (NDT) Division has been working as an excellent centre for R & D, acquisition & dissemination of knowledge and technology on NDT in the country. Since its inception, NDT Division has been working with right earnest to develop and promote the science and practice on NDT and its industrial application in Bangladesh having the objective of reducing foreign dependency and to make Bangladesh self-reliant on NDT technology for facilitating its socio-economic development.

Programme

Considering the present industrial needs NDT Division has taken up the following programs:

- ❑ Research & Development on NDT techniques those are useful to our industries
- ❑ Render valuable NDT services and consultancy to the local industries
- ❑ Training and Certification to develop expertise and proficiency of local NDT practitioners to meet international standard

1. Research and Development Work

1.1 Development of Technical Working Procedures of NDT Methods

M. F. H. Chowdhury, M. S. Alam, M. N. N. Alam, M. A. Habib, S. C. Dey

To control & maintain the quality of industrial products & to assure reliability to the users, it is required to use NDT applications in all stages of processes for the uninterrupted operation of the industrial components. Considering the demands of the industries & to make these industries benefit & productive, NDT Division is continuing its application based R&D programs. For this purpose the details technical working procedures of both conventional & advanced NDT methods like Radiographic, Ultrasonic, Magnetic Particle, Liquid Penetrant & Remote Visual Inspection have been developed to solve various technical problems exists in industries.

Depending on the geometry, dimension, orientation of the components, service condition, anticipated defect nature in the component and applicable codes & standards, the working procedures were developed for the inspection of different equipment used in various industrial sectors viz. Power Plant, Steel Structure, Fertilizer, Ship Building, Research Reactor, Gas Processing Plantsetc.

1.2 Corrosion Evaluation and Wall Thickness Measurement in Insulated Pipes by Tangential Radiography

M. F. H. Chowdhury, M. S. Alam, M. N. N. Alam, M. A. Habib, S. C. Dey

The scope of this work is to evaluate the corroded zones and to measure wall thickness of insulated pipes in order to make a correlation directly in assessing the remaining life time of power plants, petroleum and petrochemical industries etc. without removing specially insulations from the metal part so that the cause of accident due to fire & leaks, low production or unpredictable shutdown of plants can be minimized.

An attempt has been taken to develop a standard protocol for method validation to be utilized to determine remaining wall thickness of the pipe creating grooves of different depths on the external surface.

1.3 Development of Eddy Current Testing Technique for Heat Exchanger Tube

M. F. H. Chowdhury, M. S. Alam, M. N. N. Alam, M. A. Habib, S. C. Dey

Eddy Current Testing Method has been using as a quality control tool for the inspection of numerous engineering components particularly the ferro-magnetic and non-ferromagnetic Heat Exchanger Tubes, Feed Water Heater Tubes, Condenser Tubes, Air Conditioner Tubes etc. of Petrochemical Industries. A program on the above topic has been taken whose objective is to interpret the signals arising from different known defects and finding the better response of a defect at a particular frequency by utilizing Multi Frequency Eddy Current Testing Equipment – MS 5800 with Multiview 6.0R software.

Few experiments have been performed with the MultiScan MS 5800 Multi Frequency Eddy Current equipment having options to use 4 frequencies simultaneously. For this investigation, Stainless Steel tube having artificial defects of different volumes was analyzed experimentally. Data of amplitude and phases of repeated responses from various types of defect signals were collected and analyzed as an attempt to minimize the deviation of the signals emerged with respect to particular defect.

1.4 Digital Industrial Radiographic Method for Industrial Practices

M. F. H. Chowdhury, M. S. Alam, M. N. N. Alam, M. A. Habib, S. C. Dey

The scope of this work is to make the digital image of an object onto the imaging plate by the ionizing radiation and processing the image with the aid of appropriate computer facility in order to enhance their contrast & spatial resolution and to sharpen and smoothen their edge definitions for analysis of object structures.

Using X-ray Source Digital image of metal samples were analyzed to assess the integrity by adjusting different parameters available in the I See! Software.

1.5 Quality Assessment of Concrete by Ultrasonic Pulse Velocity Testing Technique

M. F. H. Chowdhury, M. S. Alam, M. A. Habib, S. C. Dey

Ultrasonic pulse velocity tests have a great potential for quality control of concrete, particularly for assessing uniformity, the presence of void, flaws, crack etc. along with the correlation of strength estimation. A program has been taken with the scope of measuring the ultrasonic pulse velocity of concrete using direct, indirect and semi-direct method to assess the quality of concrete and to measure the depth of crack in concrete by using CT 1.1 Ultrasonic Pulse Velocity (UPV) meter.

CT 1.1 Equipment has been used to take several trial data by direct method to check the performance of the equipment including adjustment of various parameters and behavior of the received signal from available concrete blocks. The obtained data is being analyzed to understand the property of the received signal. Achievement of skill on this technique and interpretation of signal by analyzing trial data will develop our skill and lead us to implement the future plan regarding R & D, application, organization of training etc. to make this technique beneficial for the end users of this country.

1.6 Ground Penetrating Radar for Buried Object Detection in Concrete and Soil

M. F. H. Chowdhury, M. S. Alam, M. A. Habib, S. C. Dey

Ground-penetrating radar (GPR) is a non-destructive testing technique that utilizes electromagnetic waves to inspect and evaluate subsurface structures in concrete and soil. A program has been taken with the objective to detect and interpret signals obtained from known buried objects in shallow depth of soil and concrete samples by obtaining reflected signals from those objects using the GPR antenna and processing the obtained signals by respective operational software.

Familiarization of the operation of the GPR equipment including the parameters of various functions is going on to develop proficiency of the personnel to adopt this newly introduced technique/technology in this division. Besides, an attempt has taken to collect data utilizing GPR equipment to understand the behavior, nature and property of the emerged signal from the samples. As a consequence of this, samples have been preparing to collect and interpret the signals for the GPR equipment. Development of expertise through the mentioned initiatives will lead to implement the future plan regarding R & D, application, training etc. for the exploration of this technique in the country.

2. Manpower Development (Training/Fellowship/Workshop/Meeting / Seminar)

2.1 Attend in Training/Fellowship/Workshop/ Meeting /Seminar

SI. No.	Title of the Program	Date	Place	Number of participants
1.	Meeting on Harmonization of National Programs for Development and Application of Advanced NDT Techniques	21 - 25 August 2023	Jakarta, Indonesia	01
2.	Regional Training Course on Phased Array Ultrasonic Testing (PAUT) with ISO 9712 Level 2 Certification	16 October to 8 November 2023	Daejeon, Korea	01
3.	Seminar on “NDT for Assurance of Quality & Safety of Mega Projects”	01 June 2024	AECD	04

2.2 Organize Training/Fellowship/Workshop/Meeting /Seminar

SI. No.	Title of the Program	Date	Place	Number of participants
1.	Seminar on “NDT for Assurance of Quality & Safety of Mega Projects”	01 June 2024	AECD	69

3. Oral/Poster Presentation in Seminar/Symposium/Conference(National and International)

Name of the Participant	Title of oral/poster presentation	Title of the event	Organizer	Date	Place
Mr. Md. Faruque Hossain Chowdhury	(i) NDT for Assurance of Quality & Safety of Mega Projects: Keynote Speech (ii) Certification Requirements for NDT Practitioners	Seminar on “NDT for Assurance of Quality & Safety of Mega Projects”	BSNDT	01 June 2024	AECD
Mr. Md. Saiful Alam	Modern NDT Methods for Ensuring Quality & Safety	Seminar on “NDT for Assurance of Quality & Safety of Mega Projects”	BSNDT	01 June 2024	AECD

4. Collaboration Work/MOU (ADP/FNCA/MEXT/FTC/IAEA/RCA/TC/S&T/CRP/In-house project, Universities, etc.)**A. Collaboration Project with IAEA**

NDT Division has been actively participating in all IAEA/RCA Program on NDT for Asia & Pacific region. The objective of this project is to maintain a uniform quality level of standard so that the certification scheme can be recognized and harmonized mutually among the RCA member states. As a part of this activity the following mentioned project has been continuing by this Division:

- “Enhancing Regional Capabilities in Advanced Non-Destructive Testing Techniques for Improved Safety and Inspection Performance in Industries (RCA) (RAS1029)”.

Within this reporting period, NDT Division has received the following equipment from IAEA under RAS1022 project:

- Ultrasonic Pulse Velocity Meter

B. Basic NDT Training for BAF Officers’

During this reporting period, the concerned persons of the NDT Division delivered theoretical lectures on different NDT methods to the 70th Flight Safety Officer's (FSO) Training Courses organized by the "Flight Safety Institute, Dhaka" of Bangladesh Air Force (BAF). Besides, the participants from Bangladesh Air Force, Bangladesh Army Bangladesh Navy and Biman Bangladesh Airlines, 01 participant from Nigerian Air force were present in this course. The NDT Division also conducted day long practical demonstration class for the above courses. This collaboration is likely to be continued.

C. Practical Demonstration for University Students

Within this reporting period, NDT Division of BAEC arranged Practical Session on different NDT methods to the program "Industrial Training Session" for 25 students of Level – 3/Term – 2 of Department of Nuclear Science and Engineering, Military Institute of Science and Technology (MIST) from 11 – 15 February 2024 to provide application based knowledge on NDT methods as a part of their curriculum activities.

D. Internship Program on Industrial Training for University Students

BAEC has collaboration with different universities to extend R & D program to attain sustainability and to promote technology in the country. Within this reporting period NDT Division of BAEC has conducted two weeks long Internship Program on Industrial Training as a part of the curriculum activities for 2 B.Sc. students of 3rd year, Department of Nuclear Engineering, University of Dhaka from 14 – 25 January 2024 to provide familiarization and application based knowledge on NDT methods.

E. Participation in the incoming inspection and document review of the LTME and Supply Equipment (SU) (Non-LTME) at Construction of Rooppur Nuclear Power Plant Project (CRNPP) Site

Expert of NDT Division was deputed by Bangladesh Atomic Energy Commission at CRNPP Site to participate in the incoming inspection and document review meeting regarding incoming inspection of LTME and Supply Equipment (SU) (Non-LTME) proposed by JSC ASE during this reporting period.

F. Bangladesh Society for Non-Destructive Testing (BSNDT)

Creating awareness on the benefits of Non-Destructive Testing technology is essential to ensure quality and safety in various industries. Keeping this in view, NDT Division has taken active role in forming a common platform for BSNDT to exchange information among the increasing number of NDT practitioners. Thus, BSNDT was formed in 1990 and has been nurtured since then by this Division. As a part of its continual support, the NDT Division has helped to organize several council meetings of BSNDT & Seminar on "NDT for Assurance of Quality & Safety of Mega Projects" during this tenure.

5. Service Rendered

One of the objectives of this Division is to render NDT services and consultancy to the local industries in both Government and Private sectors using different NDT methods e.g. Radiographic, Ultrasonic, Eddy Current, Magnetic Particle, Dye Penetrant Testing, Remote Visual Inspection for checking various industrial components.

The following industrial organizations received services rendered by NDT Division during this period:

SI. No.	Name of service provided	Number/quantity of sample/patient/service	Revenue income in BDT (if any)
1.	Radiographic Testing of Welding joints of Pipes and Plates of BSC Marine & Grain Conveyor Workshop	02	6,684/-
2.	Calibration of Ultrasonic Flaw Detector, Permanent Magnetic Yoke, Electromagnetic Yoke and Ultrasonic Thickness Gauge of Bangladesh Industrial X-ray	03	23,000/-
3.	Digital Industrial Radiographic Testing of different Tubes of Chevron Bibiyana Gas Processing Plant (South Pad, West Pad, North Pad, South South Pad and Muchai Metering Station) through Bangladesh Industrial X-ray	03	2,33,322/-

SI. No.	Name of service provided	Number/quantity of sample/patient/service	Revenue income in BDT (if any)
4.	Calibration of Ultrasonic Thickness Gauge, Ultrasonic Flaw Detector, Ultrasonic Thickness Gauge and Electromagnetic Yoke of Bay-Tech NDT & Engineering Services	02	11,000/-
5.	Calibration of Ultrasonic Thickness Gauge of Fleuve Naval Architects	01	2,000/-
6.	Calibration of Ultrasonic Thickness Gauge of Western Marine Services Ltd.	01	4,000/-
7.	Trouble shooting of Industrial Radiographic X-ray Machine of I A & E, Gazipur Cantonment, Gazipur.	01	15,000/-
8.	Calibration of UV Black Light System, Electromagnetic Yoke and Residual Field Indicator of Aerotia International	01	11,000/-
9.	Industrial Videoscope Inspection of Gas Turbine Unit- 2 of 2 × 120 MW Peaking Power Plant of Electricity Generation Company Bangladesh Ltd., Shiddirgonj, Narayanganj	01	30,000/-
10.	Radiographic Testing of Welding joint of Plate of Steelmark Buildings Ltd.	01	14,000/-
11.	Liquid Penetrant Testing of Heat Exchanger pipelines of Centre for Research Reactor (CRR), AERE, BAEC through SME Trade Corporation	06	34,938/-
12.	Calibration of Ultrasonic Flaw Detector and Ultrasonic Thickness Gauge of PEB Steel Alliance Ltd.	01	5,000/-
13.	Calibration of Electromagnetic Yoke of Innovative Engineering Services	01	2,000/-
14.	Calibration of Ultrasonic Thickness Gauge of Rifat Enterprise	01	4,000/-
15.	Calibration of Ultrasonic Flaw Detector of TUV Austria Bureau of Inspection & Certification Pvt. Ltd.	01	3,000/-
16.	Calibration of Ultrasonic Flaw Detector and Ultrasonic Flaw Detector of Radiant Engineering Training Services and Inspection Ltd.	02	12,000/-
17.	Calibration of Ultrasonic Flaw Detector and Permanent Yoke of Confidence Infrastructure Ltd.	01	5,000/-
18.	Calibration of Ultrasonic Flaw Detector, Ultrasonic Thickness Gauge, Electromagnetic Yoke and UV Black Light System of NDE Steel Structures Ltd.	01	8,000/-
19.	Calibration of 01 No. Industrial Radiographic Film Densitometer of National Tubes Ltd.	01	1,000/-
20.	Calibration of Ultrasonic Flaw Detector and Ultrasonic Thickness Gauge of Western Marine Services Ltd.	01	5,000/-
21.	Calibration of Ultrasonic Flaw Detector, Thickness Gauge and Electromagnetic Yoke of Marine NDT & Engineering Works	01	7,000/-
22.	Calibration of Ultrasonic Flaw Detector, Thickness Gauge of Bureau Veritas (Bangladesh) Private Ltd.	01	7,000/-

Accelerator Facilities Division, AECD

Objective

The objectives of this Division are (a) management of the 3 MV Van de Graaff Accelerator and its associated sub-systems (b) irradiation and analysis of spectrum data for elemental assessment of environment samples (c) utilization of ‘Gamma Spectroscopy Setup’ for the detection & analysis of radiological substances in different foodstuff & environment samples.

Programme

Accelerator Facilities Division of the Atomic Energy Centre, Dhaka operates and maintains the 3 MV Van de Graaff Accelerator and its associated sub-systems, which is capable of producing and accelerating proton beam in the range of nano to micro-amperes. The proton beam & associated facilities are being utilized for the irradiation of different samples. This division has also been developed a ‘Gamma Spectrometry System’ using existing HPGe detector, Lead shielded chamber, spectroscopy amplifier, MCA and with other associated electronic circuitries. Gamma spectrometry data acquisition setup is being used for the detection and analysis of radiological substances, their activities in various specimens of the earth surface and the products.

1. Research and Development Work

1.1 Management of the 3 MV VDG Accelerator and Gamma Spectrometry System

Dr. Md. Joyanal Abedin, M. Mahfuzur Rahman, Lokman Hossain

The main objective is to keep the accelerator and ‘Gamma spectrometry’ data acquisition setup operational, to detect & analyze of radiological substances accumulated in different samples for research purpose.

‘Gamma data acquisition setup’ of Accelerator Laboratory of AECD is being applied for detection & analysis of radiological substances accumulated in different specimens collected from Coal Mine area, Cox’s Bazar Sea Beach area, soil of potato field, medicinal plants, vegetables, foodstuffs, and other samples those are imported & locally produced. Collected samples were preserved in vacuum desiccators for the protection of further contamination. Different samples were taken under experiments separately; emitted gamma energy lines from different radionuclides were being collected, and analyzed using controlling software Genie-2000. The accelerator was not taken under operation due to lack of manpower. Vacuum pumping system, chiller for water cooling circulation and gas drying system are essential for accelerator operation. Each of the sub-systems needs at least two technically skilled manpower.

The students of different universities have been done their thesis experiments for PhD, MPhil and MS degrees using ‘Gamma Spectroscopy data acquisition setup’ of VDG Accelerator laboratory.

1.2 Radiological Assessment of Potato Cultivated Field and its Effects on Environment

Joyanal Abedin, M. M. Rahman, Lokman Hossain, Farhana Afrin*

Detection of radiological substances accumulated in soil of potato cultivated field, their impacts on the environment as well as on living beings.

Soil samples were taken from different depth and locations of potato cultivated field, processed & given under gamma experiment for the detection of radiological substances accumulated somehow. The collected soil samples were 1000gm each. Each of the samples was taken under gamma experiments about 7065 seconds for data acquisition. The gamma energies emitted from the radionuclides accumulated in samples were detected by the HPGe detector, converted into voltage pulses, amplified and processed by MCA unit to display on monitor. Data acquisition and spectrum analysis were done by Genie-2000 software. Detected radionuclides show their own energy lines through the spectrums. The analyzed energy lines of different radionuclides from one of the soil samples are projected below;

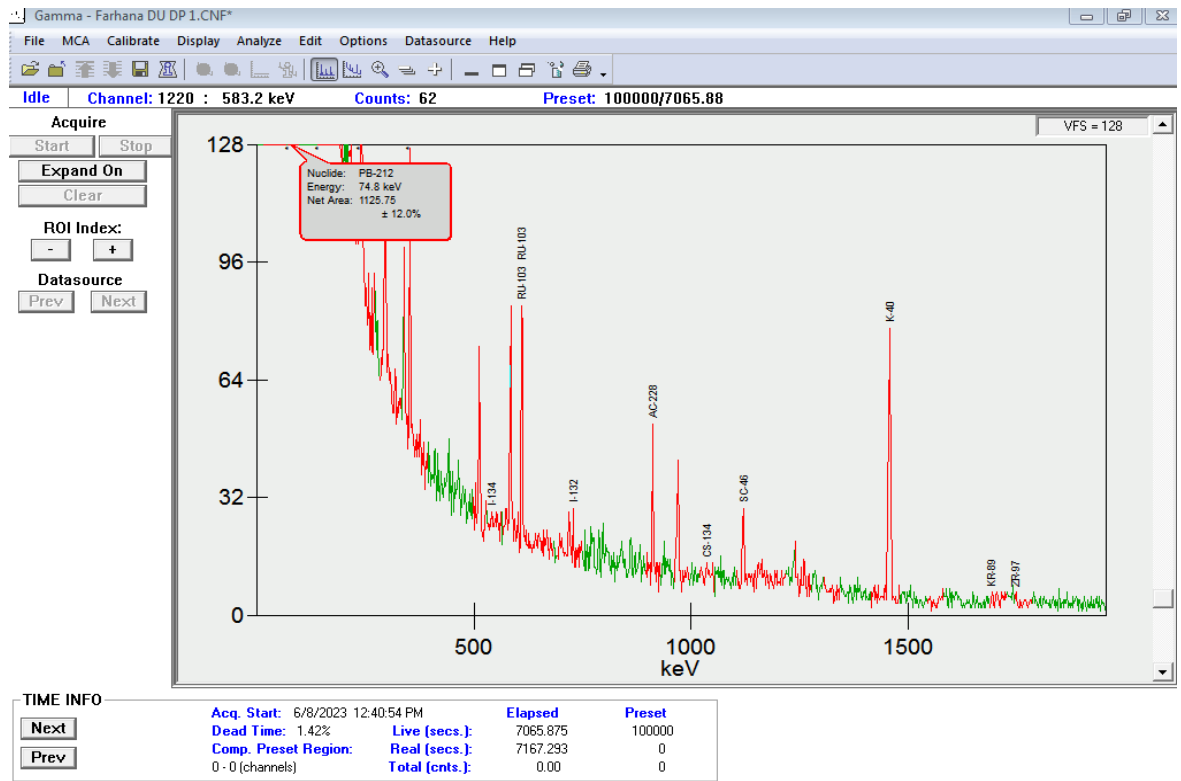


Fig: Analyzed spectrum of one of the soil samples (DP-1) from potato cultivated field

Sample Title : Radiological substances detection
 Sample Identification : DP 1
 Sample Taken On : 6/8/2023 2:40:00 PM
 Acquisition Started : 6/8/2023 12:40:54 PM
 Live Time : 7065.9 seconds
 Real Time : 7167.3 seconds
 Dead Time : 1.42 %

 ***** P E A K A N A L Y S I S R E P O R T *****

Peak	ROI	ROI	Peak	Energy	FWHM	Net Peak	Net Area	
Continuum	No.	start	end	centroid	(keV)	(keV)	Area	Uncert. Counts
1	143-	188	155.77	74.46	4.18	1.078E+03	64.64	3.636E+03
2	143-	188	178.56	85.35	4.24	3.991E+02	55.65	3.821E+03
3	263-	283	272.41	130.22	0.64	1.827E+02	115.35	3.617E+03
4	377-	409	388.58	185.75	2.77	1.943E+02	145.79	4.105E+03
5	487-	517	499.61	238.82	2.35	1.268E+03	120.77	2.730E+03
6	606-	628	616.95	294.91	1.94	1.582E+02	75.86	1.444E+03
7	698-	748	708.10	338.48	1.87	1.704E+02	24.24	6.133E+02
8	698-	748	736.38	352.00	1.90	3.520E+02	28.05	6.098E+02
9	911-	981	920.69	440.10	3.28	6.645E+01	21.36	5.333E+02
10	911-	981	970.09	463.71	3.33	8.980E+01	22.26	5.301E+02

11	1058-	1081	1069.72	511.34	2.01	2.630E+02	48.41	5.200E+02
12	1207-	1290	1221.32	583.80	2.44	3.367E+02	23.91	3.192E+02
13	1207-	1290	1276.51	610.19	2.49	3.574E+02	24.06	3.105E+02
14	1513-	1536	1524.64	728.79	1.98	5.992E+01	36.17	3.091E+02
15	1635-	1678	1646.67	787.13	1.82	3.434E+01	11.51	1.374E+02
16	1635-	1678	1664.22	795.52	1.83	2.775E+01	11.50	1.485E+02
17	1790-	1813	1801.87	861.31	2.33	7.250E+01	30.37	2.125E+02
18	1896-	2041	1908.61	912.33	2.67	2.298E+02	18.74	1.782E+02
19	1896-	2041	1956.57	935.26	2.70	5.794E+00	4.47	1.678E+02
20	1896-	2041	2028.96	969.87	2.75	1.549E+02	15.33	1.380E+02
21	2333-	2358	2345.28	1121.07	2.04	1.305E+02	27.69	1.495E+02
22	2578-	2603	2590.32	1238.20	1.14	3.763E+01	30.43	2.064E+02
23	3034-	3069	3051.40	1460.60	4.83	7.061E+02	39.23	1.519E+02

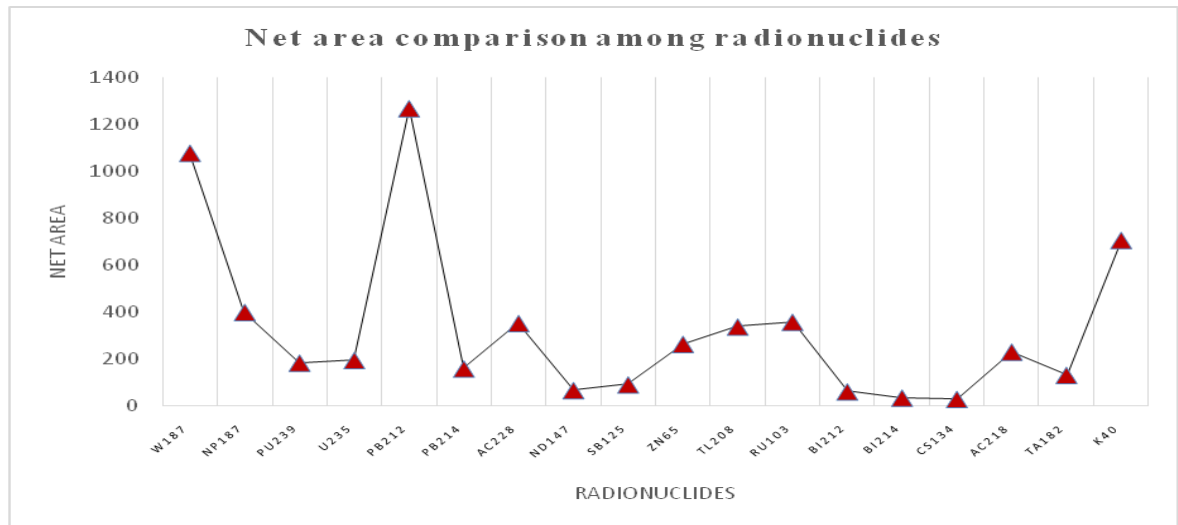


Fig: Net area comparison among radionuclides detected in soil samples (DP-1) of a potato cultivated field

1.3 Radiological assessment of ^{131}I Radioactive Wastage Syringe (Used) Collected from NINMAS, Dhaka

Joynal Abedin, Lokman Hossain, M. Safiul Islam*

The objective of this research work is to study the radioactivity decay during each of the half-life of ^{131}I

The wastage syringe samples were collected from NINMAS, BSMMU within appropriate lead shielded block and preserved into another shielding box separately and kept in safe area to protect other contamination. Within a short period of time, the samples were set in lead shielded chamber for gamma experiments separately. The experiment time of each sample was about 2000 seconds. The gamma energies (photons) emitted from ^{131}I isotope were detected by the HPGe detector. The energy spectrums were collected, processed by 'data acquisition setup'. The entire process is being controlled by Genie-2000 software. The collected data were also analyzed using the same software. Five different gamma energies were emitted and detected, analyzed energy spectrums of one of the wastage syringe are shown below;

Table: Collected wastage syring esamples from NINMAS, BSMMU

Sample ID	Location of sample	Type of Sample	Initial Activity(μCi)
^{131}I :001	NINMAS	Wastage Syringe	321.10

^{131}I :002	NINMAS	Wastage Syringe	564.00
^{131}I :003	NINMAS	Wastage Syringe	229.30
^{131}I :004	NINMAS	Wastage Syringe	215.10
^{131}I :005	NINMAS	Wastage Syringe	297.00

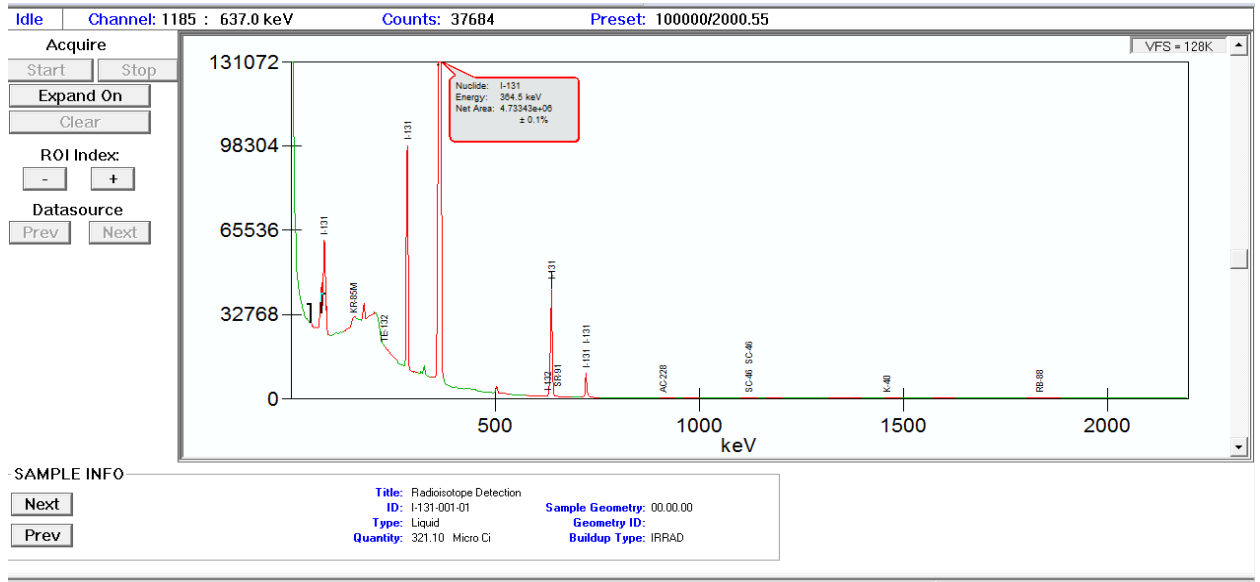


Fig: Analyzed energy spectrum of one of the wastage syringe from NINMAS, BSMMU

Analyzed Result:Filename: C:\GENIE2K\CAMFILES\NINMAS- ^{131}I -001-01.CNFSample Description : Wastages syringe ^{131}I , NINMASSample Identification : ^{131}I -001-01Initial Activity : 215.1 μCi

Live Time : 2000.6 seconds

Real Time : 2267.3 seconds

Dead Time : 11.76 %

Peak No.	ROI start	ROI end	Peak centroid	Energy (keV)	FWHM (keV)	Net Peak Area	Net Area Uncert.	Continuum Counts
1	114	169	148.16	80.60	3.28	1.453E+05	618.89	3.624E+05
2	263	338	328.04	177.13	10.56	2.985E+04	847.48	8.719E+05
3	511	552	528.26	284.58	2.26	3.285E+05	1531.05	3.216E+05
4	595	630	605.73	326.16	2.15	3.826E+03	1106.13	2.217E+05
5	652	703	677.69	364.77	2.31	1.522E+06	2240.74	2.145E+05
6	919	962	935.97	503.37	2.43	1.138E+04	559.14	4.626E+04
7	1162	1214	1185.82	637.46	2.47	1.741E+05	547.77	1.657E+04
8	1324	1374	1346.10	723.46	2.58	4.201E+04	307.69	7.363E+03
9	2706	2733	2719.40	1460.43	2.85	1.709E+02	19.16	4.410E+01

Table: Radioactive Decay of ^{131}I with different half life

SL	Time Duration in Half live	Activity in (μCi)	Activity in (Bq)	Spectra line-01 Net Area	Spectra line-02 Net Area	Spectra line-03 Net Area	Spectra line-04 Net Area	Spectra line-05 Net Area
1	0	215.1	7958700	1.45E+05	3.42E+05	1.52E+06	1.74E+05	4.20E+04
2	1	107.55	3979350	7.91E+04	1.69E+05	9.30E+05	8.76E+04	2.01E+04
3	2	53.775	1989675	3.92E+04	8.77E+04	5.14E+05	4.48E+04	9.97E+03
4	3	26.8875	994837.5	1.99E+04	4.43E+04	3.21E+05	2.77E+04	5.01E+03
5	4	13.44375	497418.75	1.06E+04	2.20E+04	1.88E+05	1.08E+04	2.48E+03
6	5	6.721875	248709.375	5.94E+03	1.15E+04	1.03E+05	5.91E+03	1.33E+03
7	6	3.3609375	124354.6875	2.60E+03	4.66E+03	5.07E+04	2.37E+03	5.78E+02
8	7	1.68046875	62177.34375	7.24E+02	2.95E+03	2.87E+04	1.34E+03	2.96E+02
9	8	0.840234375	31088.67188	5.76E+02	1.42E+03	1.46E+04	7.80E+02	1.26E+02

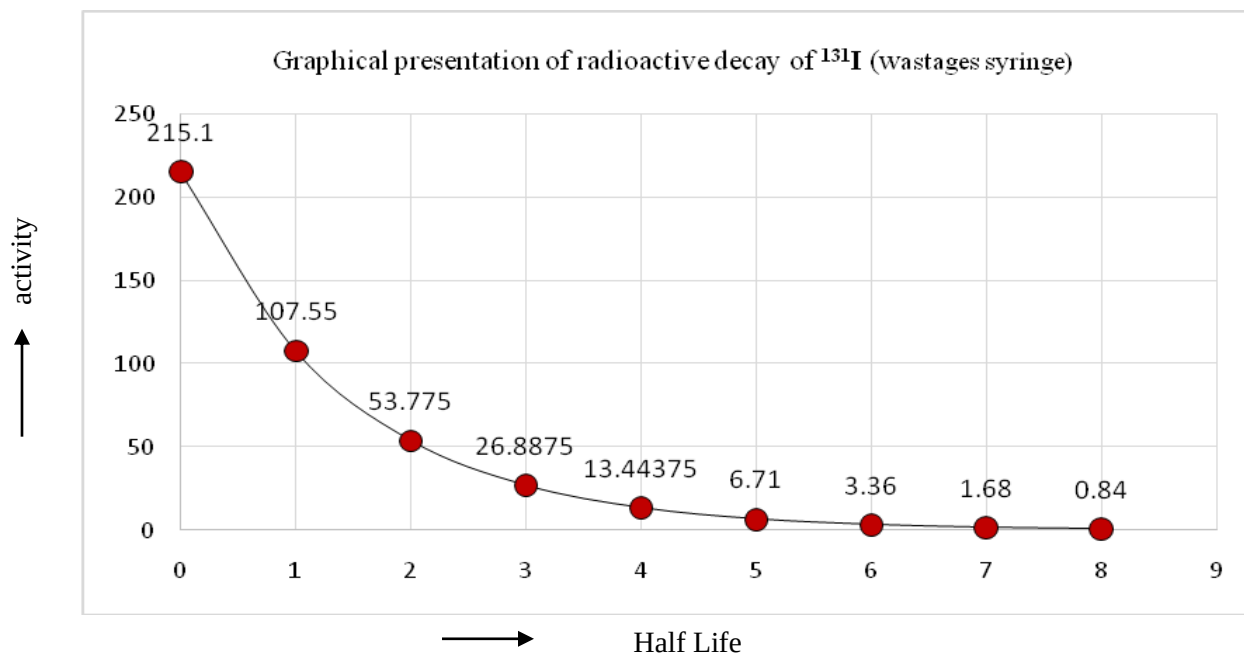


Figure: Graphical presentation of radioactive decay of ^{131}I

1.4 Detection of Radiological Substances and Health Risks Assessment of AMA Powder Milk

Joynal Abedin, M. M. Rahman, Lokman Hossain, Ashfia Rahmann

The main objective of the study is to detect radionuclides accumulated in AMA full cream powder milk and analyze their activity concentration for the assessment of pollution level & health risks.

Five packets of AMA powder milk (1000gm each) were collected from local market and taken under experiments to detect the radiological contamination. Each of the samples kept under experiment about 9188 seconds. The emitted gamma photons were detected using data acquisition setup. The controlling software 'Genie-2000' was applied for data acquisition and analysis. The analyzed gamma energy spectrum, possible radionuclides and their activity concentration of one of the samples are projected below;

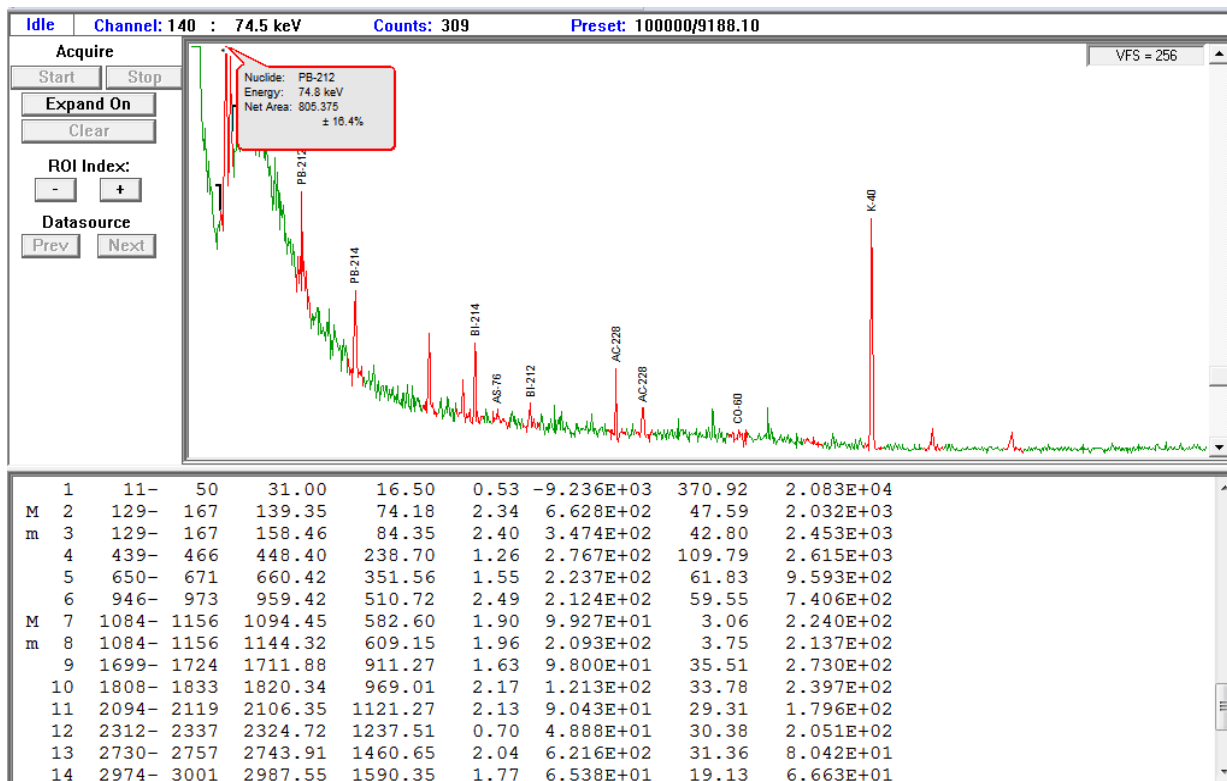


Figure: Analyzed energy spectrum& a part result of 'AMA' full cream powder milk.

Table: Possible nuclides, Energy lines & activity concentration of 'AMA' powder milk.

Possible Nuclides	Energy (KeV)	FWHM (KeV)	N. Peak Area	N. Area Uncert.	Activity con. (Bq/Kg)
¹⁸⁷ W	74.24	2.34	662.80	74.24	234.378
²³⁷ Np	84.42	2.40	347.40	42.81	33.228
²¹² Pb	238.89	1.26	276.70	109.79	18.744
²¹⁴ Pb	351.85	1.56	223.70	61.83	27.236
⁶⁵ Zn	511.15	2.49	212.40	59.55	468.549
²⁰⁸ Tl	583.09	1.90	99.25	3.06	10.705
²¹⁴ Bi	609.66	1.96	209.30	3.75	46.794
²²⁸ Ac	912.04	1.63	98.00	35.51	29.174
²²⁸ Ac	969.82	2.17	121.30	33.78	70.342
¹⁸² Ta	1122.20	2.13	90.43	29.31	25.424
⁵⁶ Co	1238.54	0.70	48.88	30.38	48.767
⁴⁰ K	1461.87	2.05	621.60	31.36	932.060
¹⁵⁴ Eu	1591.67	1.77	65.38	19.13	490.622
²¹⁴ Bi	1761.67	1.04	81.09	15.99	597.330
Total Activity concentration (Bq/Kg)					3033.346

Total activity concentration of 'AMA' powder milk is 859.863 Bq/Kg and radiation comparison among detected nuclides shows ⁴⁰K > ²¹⁴Bi > ¹⁵⁴Eu > ⁶⁵Zn > ¹⁸⁷W > ²²⁸Ac > ⁵⁶Co > ²³⁷Np > ¹⁸²Ta > and ²¹²Pb > ²⁰⁸Tl.

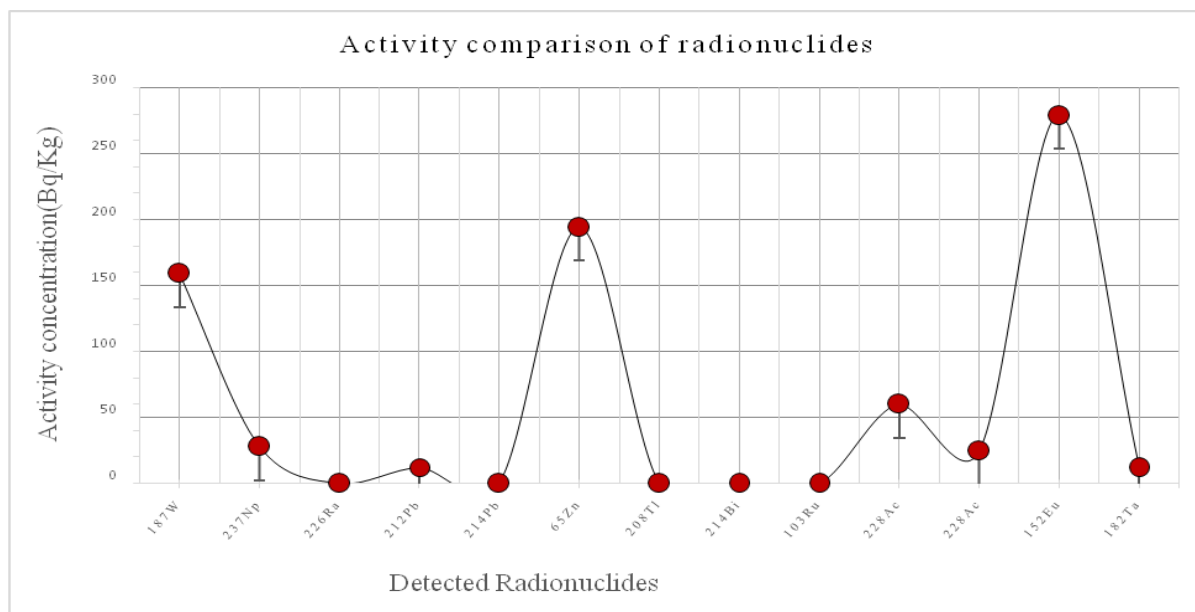


Figure: Activity comparison of radionuclides in 'AMA' powder milk

1.5 Study of Environment Pollution of 'Waterfall Hill North Side' due to Heavy Metal Contamination

Joynal Abedin, M. M. Rahman, Lokman Hossain, M. Safiul Islam*

The main objective of this study is to detect the elements, their concentration, and health risks assessment due to toxicity.

Soil samples were collected from the surrounding area of 'Waterfall Hill North Side', different distance & depth, dried, ground as fine powder and made as pellets (7mm diameter & 1mm thick). The pellets were preserved in vacuum desiccator and taken under PIXE experiment & irradiated by 2.4 MeV proton beam with the beam current of 10 to 15 nA. The data acquisitions were done using controlling software MAESTRO-32 and the spectrum data files were analyzed by the commercial software GUPIX-32. The analyzed spectrum of one of the soil sample is given below;

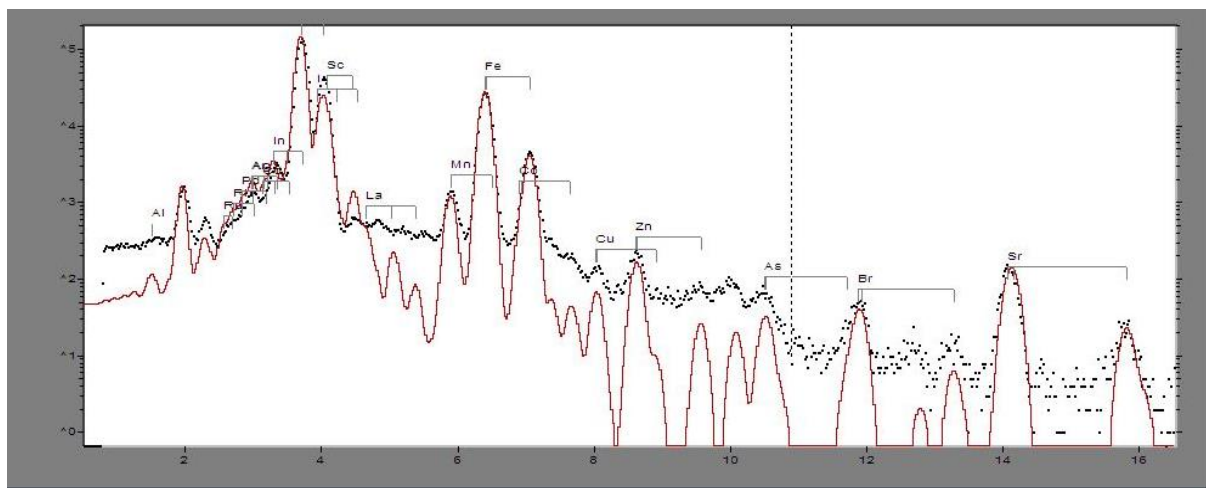


Figure: PIXE analyzed spectrum of soil sample of JWAS-001

spectrum analyzed Report of JWAS-001:

Element	Area	value	/uC/	Eff. Trans.	Conc.	%Stat.	%Fit	LOD	
Z Sym	#	counts	(-5)	ppm (-3)	(-5)	ppm	Error	Error	ppm

13	AlK	1	33.6	330	7883	437	143	2074.7	174.79	176.38	7728.5	N
14	SiK	1	160.8	330	9993	597	1508	542.2	35.99	42.69	345.9	?
15	P K	1	0	330	3852	611	6281	0	0	0	288.8	N
16	S K	1	0	330	4481	692	15719	0	0	0	74.5	N
19	K K	1	40082.8	330	4065	857	53178	6558.0	0.47	1.20	22.3	Y
20	CaK	1	41672.7	330	4155	888	63377	5396.3	0.63	1.35	47.7	Y
22	TiK	1	18327.3	330	3752	932	78022	2036.2	0.72	1.45	12.9	Y
24	CrK	1	366.7	330	3506	956	86762	38.2	15.66	15.45	11.0	?
25	MnK	1	2818.1	330	3090	965	89655	319.5	2.49	3.20	11.8	Y
26	FeK	1	187136	330	2788	971	91869	22789.8	0.19	1.03	8.0	Y
29	CuK	1	0	330	1522	984	95884	0	0	0	11.1	N
30	ZnK	1	238.8	330	1269	986	96675	59.8	7.03	8.85	2.5	Y
32	GeK	1	10.8	330	806.4	990	97787	4.2	140.02	141.05	10.2	N
37	RbK	1	113.2	330	250.2	993	99110	139.2	12.21	16.43	33.0	Y
38	SrK	1	122.1	330	197.7	993	99246	189.9	9.73	12.47	23.2	Y
40	ZrK	1	50.7	330	124.6	992	99449	125.2	18.76	25.72	42.0	?

Table: Elemental concentration of JWAS-001

Z	Elements	Concentration (ppm)	LOD	Error (%)
14	Si	542.2	345.9	42.69
19	K	6558.0	22.3	1.20
20	Ca	5396.3	47.7	1.35
22	Ti	2036.2	12.9	1.45
25	Mn	319.5	11.8	3.20
26	Fe	22789.8	8.0	1.03
30	Zn	59.8	2.5	8.85
37	Rb	139.2	33.0	16.43
38	Sr	189.9	23.2	12.47

Figure: Graphical projection of elemental concentration (ppm) of soil sample JWAS-001

A PhD thesis will be submitted to the Department of Physics, Jahangirnagar University under this research program.

* Department of Physics, Jahangirnagar University, Savar.

Plasma Physics Division, AECD

Objective

The plasma physics division is the newest division of the Atomic Energy Center, Dhaka (AECD) which is started to work in January 2016 to promote fundamental, advanced and applied research works in the related areas of plasma physics. The major objective of the division is to build capacity in the related areas of plasma science and plasma based technology development. The major areas of research and development are as follows: Theoretical, computational and experimental studies on the Space plasma, Astrophysical plasma, Industrial plasma, and Fusion plasma, Quark-gluon plasma, etc.

1. Research and Development Work

1.1 Optimization of a Dense Plasma Focus (DPF) Fusion Device and Design and Development of an Efficient DPF Device

M. A. Malek and M. K. Islam

Current progress: A dense plasma focus (DPF) fusion device is a high pulsed co-axial accelerator that produces a high-density, high-temperature plasma along with pulsed x-rays, neutrons, electrons, ions, and electromagnetic waves. The plasma focus device is composed with two sections: The first section is pre-pinch (axial) section and the second one is the radial pinch phase section. We have studied numerically the fusion neutron and soft X-ray production from a low energy DPF as a function of pressure and the dimension of electrodes.

1.2 Photoelectric Effect in the Collective Behavior of Collisional, Streaming and Magnetized/Unmagnetized Dusty Plasmas

M. S. Munir, A. Hossain, M. K. Islam, M. Salahuddin

The conditions of instability of electrostatic dust modes in magnetized/unmagnetized dusty plasmas with negatively charged dust grains, streaming and collisional effect are investigated theoretically. We find that the ultra-low frequency DLH mode can be unstable due to photoelectric effect when the streaming velocity of electron is sufficiently low. In the case of DIA mode, we also found that the photoelectric effect has significant effect on the mode and the growth rate of the instability of the DIA mode increases with the increase of photon energy. This study will help the researcher to understand the effect of photoelectron on the Dust Ion Acoustic (DIA) and Dust Lower Hybrid Mode (DLH) modes in dusty plasmas in both laboratory and space, such as the planetary rings, the lower ionosphere/magnetosphere of the Earth, interstellar space cloud, etc.

2. Oral /Poster Presentation in Seminar/Symposium/Conference(National and International)

Name of the Participant	Title of oral/poster presentation	Title of the event	Organizer	Date	Place
M. A. A. Mamun, S. Biswas, M. K. Islam , et al.	Digitizing and matching of measured current profile to computed one of plasma focus device using lee code, Phy PS-4	1 st National Conference on Advances in Science and Technology	BUET	7-8 December, 2023	Dhaka, Bangladesh
Dr. Md. Khairul Islam	Photoelectric effect in collective process of dusty plasmas: A new theory of radar echoes	Seminar and Workshop on “Development of Physics Research Skills at National University”	Bangladesh Physical Society	27 February, 2004	Mohammadpur, Kendriya College, Dhaka, Bangladesh
Dr. Md. Khairul Islam	Towards the Achievement of Fusion Reactor	BCSIR Congress-2023	BCSIR	08-10 March 2024	BCSIR, Dhaka, Bangladesh
M. K. Islam, et al.	Instability of plasma modes in ionospheric dusty plasmas, PHP-1,	National Conference on Physics for the 21 st Century,	Physics Discipline, Khulna University	18 May, 2024	Khulna, Bangladesh
M. S. Munir, M. K. Islam, et al.	Photoelectric effect on Dust-Lower-Hybrid mode in streaming dusty plasmas with dust charge, PHP-3	National Conference on Physics for the 21 st Century	Physics Discipline, Khulna University	18 May, 2024	Khulna, Bangladesh
M. I. Nayeem, J. A. Rony, S. Biswas, M. K. Islam, et al.	Optimization of X-ray emission for hydrogen gas from FMPF-1 plasma focus device using Lee code, PHP-4	National Conference on Physics for the 21 st Century	Physics Discipline, Khulna University	18 May, 2024.	Khulna, Bangladesh
M. A. H. Talukder, M. K. Islam, et al.	Excitation of low frequency electrostatic dust modes and the critical condition for dust lower hybrid mode in magnetized dusty plasma, PHP-5	National Conference on Physics for the 21 st Century	Physics Discipline, Khulna University	18 May, 2024.	Khulna, Bangladesh
Dr. Md. Khairul Islam	Photoelectric effect in collective process	Seminar and Workshop on “The	Bangladesh Physical	27 June, 2004	AIUB, Dhaka, Bangladesh

	of dusty plasmas: A new theory of radar echoes	Advancement of Physics Research for Engineering Students”	Society		

3. Stakeholder Meeting

Sl. No	Title of the program	Date	Place	Number of participants
01.	Photoelectric effect in collective process of dusty plasmas Speaker: Dr. Md. Khairul Islam	May 29, 2024	Auditorium, Atomic Energy Centre, Dhaka	55

4. Collaboration work/MOU (ADP/FNCA/MEXT/FTC/IAEA/RCA/TC/S&T/CRP/In-house project, Universities, etc.)

- Establishing Dense Plasma Focus Device in Khulna University.” Ref.: 37.20.0000.004.033.020.2022 (Part-4)-596, Since 2022
- To enhance the capabilities of the Plasma Physics Division, the division is collaborating with the Plasma Research Center, University of Tsukuba, Tsukuba, Japan, Since 2015
- Research on dense plasma focus fusion device is ongoing in collaboration with ICTP (International Center for Theoretical Physics), Italy, Since 2015

ATOMIC ENERGY RESEARCH ESTABLISHMENT (AERE), SAVAR

CENTRE FOR RESEARCH REACTOR (CRR), AERE

Objective

Center for Research Reactor (CRR) has been operating and supervising the Bangladesh's only nuclear research reactor named "BAEC TRIGA Research Reactor (BTRR)". It is a light water cooled, graphite reflected reactor, designed for steady state and square wave operation up to a power level of 3 MW (thermal) and for pulsing operation with a maximum pulse power of 852 MW. The reactor achieved its first criticality on 14 September 1986. With the aim of socio-economic development of the country, this reactor facility is being used in various fields of research and utilization such as Neutron Activation Analysis (NAA), Neutron Radiography (NR), Neutron Scattering (NS), experimental reactor safety research, isotope production and human resource development through education & training programme for nuclear research and power program of the country.

R&D work(s)

During the reporting period, the reactor was operated at different power levels depending on the requirements for reactor physics experiments conducted by CRR personnel and to provide neutron beam for various reactor users. The total operating hour was about 37.98 hr and total burn up of the reactor fuel was about 12.86 MWh. A total number of 104 samples were irradiated through 04 irradiation requests (IRs). Nuclear safety is the most important issues in the nuclear installations. The important reactor safety parameter such as burn up estimation, control rod worth, core excess reactivity, shutdown margin, loss of reactivity with power increases, reactivity coefficients, thermal hydraulic analysis and thermal power calibration of the reactor were measured during the reporting period by scientist/engineer of CRR. Study on these safety parameters of the nuclear reactor is very important for reactor safety and efficient operation.

Different groups of the Institute of Nuclear Science and Technology (INST) used the neutron beam of the reactor to carry out various Research and Development (R&D) activities. Neutron Activation Analysis technique is used to determine the trace elements present in soil, foodstuff, and vegetable samples. The Neutron Radiography group used the NR technique to detect voids, cracks, internal continuity in materials and determine water absorption behavior of jute plastic composites and various types of building materials

e.g. bricks, tiles, etc. The scattering group used High Performance Powder Diffraction technique to characterize materials crystallographically and magnetically. The micro-structural information is obtainable by neutron scattering method which is very essential for determining its technological applications. This technique is unique for understanding the magnetic behavior in magnetic materials. Ceramic, steel, electric and electronic industries can be benefited from this facility to improve their products and fabrication process.

Reactor is operated for training, research, practical experiments related to safety, industrial attachment program for students from different universities as well as for trainee from BAEC training institute. During the reporting period, 36 (Thirty six) students from the Department of Nuclear Science and Engineering, MST, Dhaka, 134 (One Hundred Thirty Four) students from the Department of Electrical and Electronic Engineering IUT, Gazipur have completed their practical experiments using the facility of CRR.

1. Manpower Development (Training /Fellowship/ Workshop/Meeting)

2.1 Attend Intraining/Fellowship/Workshop/Meeting

Sl. No	Title of the program	Date	Place	Number of participants
1.	Neutron Flux Monitoring System of BTRR	30 July, 2023	CRR	19
2.	Conceptual Configuration of OWS (Operator Work Station) of I&C System	30 July, 2023	CRR	19
3.	Dismantling and Training of Existing Digital Console of BTRR	17 August, 2023	CRR	06
4.	Installation and Training of New Heat Exchanger of BTRR	17 August, 2023	CRR	12
5.	Overview of BAEC TRIGA Research Reactor (BTRR)	21 September, 2023	CRR	19
6.	Emergency Response Plan and Practical Demonstration on Emergency Evacuation	25 September, 2023	CRR	15
7.	Emergency Response Plan and Practical Demonstration on Emergency Fire Response	25 September, 2023	CRR	15
8.	Dismantling and Training of Existing Digital Console of BTRR	25 September, 2023	CRR	07
9.	Installation and Training of New Heat Exchanger of BTRR	25 September, 2023	CRR	08
10.	Field Instrument Installation for New Digital Console of BTRR	17 October, 2023	CRR	14
11.	Control Rod Drive Mechanism Setup for New Digital Console of BTRR	22 October, 2023	CRR	14
12.	IAEA Safety Standards and Services on Research Reactors	27 November, 2023	CRR	12
13.	Safety Standards and Services on Research Reactor Training and Qualification	27 November, 2023	CRR	12
14.	Emergency Response Plan and Practical Demonstration on Emergency Evacuation	26 December, 2023	CRR	11
15.	Emergency Response Plan and Practical Demonstration on Emergency Fire Response	26 December, 2023	CRR	11
16.	Systems Upgradation and Modernization of BTRR	23 January, 2024	CRR	16
17.	Cooling System Integration with the New Console of BTRR	28 January, 2024	CRR	15
18.	Comparison between old operating system with the new PLC-based operating system of the	27 February, 2024	CRR	14

	demineralized water treatment plant			
19.	Overview of the new PLC-based operating system of the demineralized water treatment plant	27 February, 2024	CRR	14
20.	Comparison Between Old Ventilation System with the New PLC-based Ventilation System	24 April, 2024	CRR	15
21.	Overview of the New PLC-based ventilation system	24 April, 2024	CRR	15
22.	Radiological Dose Assessment of BAEC TGIGA Research Reactor	28 May, 2024	CRR	16

3. Stakeholder Meeting

Sl. No	Title of the program	Date	Place	Number of participants
1.	Stakeholder Meeting with scientists from RNPd, HPRWMU and NRCD of INST.	24 March, 2024	CRR	10

4. Collaboration work/MOU (ADP/FNCA/MEXT/FTC/IAEA/RCA/TC/S&T/CRP/In-house project, Universities, etc.)

ADP Project: Balancing, Modernization, Refurbishment and Extension (BMRE) of Safety Systems of the 3 MW TRIGA Mark-II Research Reactor Facility at AERE, Savar, Dhaka. Under this project several systems of the BTRR are being upgraded for the purpose of long term (about 15-20 years) operation of the BTRR.

5. Repair & Maintenance, Renovation works, etc.

Some of the non-routine maintenance works performed during the reporting period is listed below in chronological order:

July-23	- Maintenance of pneumatic doors. - Maintenance of Hand and Foot monitor. - An electric cable fault occurred at street lights. This fault was identified and solved successfully and ensured the security of the reactor facility. - The PLC based ventilation system was placed on the 3rd floor. - The old compressor was replaced by a new one to run the ventilation system smoothly. - Renovation and strengthening safety of existing 5-Ton capacity overhead crane of Reactor Building based on detailed engineering inspection by the experts.
August-23	- The existing Heat exchanger is replaced by a new heat exchanger. - The existing digital console was dismantled. - Cabinets of new digital console were installed. - Maintenance of central air conditioner system. - Installation of new I&C system. - The heater bypass was removed from central AC to ensure the passage of air to the heater core in heat mode. - On the 3rd floor roof, 10 Nos LED lights were set up and replaced the old lights to increase the visibility. - Repair & Maintenance work of Air-tight Door Control System, Central Air Conditioning System, Air Compressor, VFD including DM Plant Accessories.
September-23	- The ventilation system and pneumatic door control board were modified in the control room. - Maintenance of CCTV camera system. - Installation of water dilute system in the ventilation system. - Installation of thermowell in primary and secondary pipeline.

	• NDT test in the primary and secondary pipeline. • Installation of new I&C system. • As a part of quarterly survival checklist completion, the 11KV Sub-station system and generators were cleaned according to the guideline. • A 10HP Submersible pump was replaced by a new one in the pump room to increase the flow of water. • Maintenance and Up-gradation work of Online Purification System, DM Plant and Emergency Core Cooling System (ECCS) of BTRR.
October-23	• Installation of new sensors (pressure, temperature, water level, electrical conductivity, water flow) and transmitter. • Installation of cable tray and laying cables. • Installation of new UPS for new digital console. • Calibration of sensors. • Installation of new I&C system. • Fuel store room electrical light connections were modified to increase visibility. • Unused electric cable was removed from the primary and secondary pump rooms and newly established cable channel. • The 250A MCCB circuit breaker was changed in E/M dark room DB board. • Repair, Maintenance & Renovation Work of Reactor Hall Ventilation System with PLC, Filtration System, Water Deluge System, Instrument Air Compressor, Air Drier and other related work. • Quarterly Surveillance program was performed.
November-23	• Installation of new I&C system. • Repair and maintenance work on sleep and window type AC were done properly. • The UPS battery changed in the TAS room. • Supply, Installation & Commissioning of Cross Flow Induced Draft Type Cooling Tower including chemical dosing system, spare electric motors, High Radiation Tolerant Under Water LED light set and other related work.
December-23	• Installation of new I&C system. • As a part of quarterly survival checklist completion, the 11KV Sub-station system and generators were cleaned according to the guideline. • Solenoid valves, light and electric cable cables are installed in the cooling tower. • Annual maintenance and surveillance activities were performed.
January-24	• Maintenance of new Radiation Monitoring Equipment (ARM). • Maintenance of new stack monitor and continuous air monitoring system. • Installation testing and commissioning of distribution board with necessary circuit arrangements as well as star to delta conversion system for the newly installed cooling tower. • Primary and secondary pump motor of reactor coolant system has been replaced with the new pump motors to avoid the aging degradation of old pumps and hence ensured proper coolant circulation both in primary and secondary circuits.
February-24	• Troubleshooting and maintenance of hand and foot radiation monitor. • Troubleshooting and maintenance of variable frequency driver (VFD). • Four new VFD (Variable Frequency Drive) has been installed for the primary and secondary pump motors to ensure soft starting as well as smooth operation.
March-24	• Routine functionalities check of all instruments of digital control console of BAEC TRIGA research reactor (BTRR). • As a part of quarterly survival checklist completion, the 11KV Sub-station system and generators were cleaned according to the guideline.
April-24	• Routine health checkup and functionality check of Digital Console Software (TRIGA

	Application). Repair and maintenance work on the central AC was done properly. New connection board has been installed with necessary breakers and cables.
May-24	Secondary Pipe line Strainer Cleaning: Water remove of the secondary pipe line, Strainer cleaning and Priming of the Secondary pump.
June-24	Semi-Annual maintenance and Surveillance program were performed.

INSTITUTE OF NUCLEAR SCIENCE AND TECHNOLOGY (INST), AERE

Radioisotope Production Division, INST

Objective

The Radioisotope Production Division (RIPD) of the Bangladesh Atomic Energy Commission (BAEC) aims to achieve self-sufficiency in the production of radioisotopes and radiopharmaceuticals for medical use. Key products include $\text{Na}^{99\text{m}}\text{TcO}_4$ (for intravenous administration) and Na^{131}I solution (for oral administration), which are widely used in nuclear medicine centers across Bangladesh, including both public and private hospitals. By locally producing the $^{99}\text{Mo}/^{99\text{m}}\text{Tc}$ generator, RIPD has eliminated the need for imports, ensuring a reliable and steady supply of these essential radioisotopes.

To support radiopharmaceutical production, RIPD has set up an ISO-certified clean room facility. This facility is equipped to manufacture $^{99\text{m}}\text{Tc}$ cold kits, such as MDP, DPTA, and DMSA, which are crucial for specific diagnostic procedures. RIPD is also working towards obtaining the necessary drug licenses and certifications for radiopharmaceutical production. Through these initiatives, RIPD is advancing nuclear medicine and enhancing healthcare in Bangladesh.

Activities

1. Radioisotope Production:

- Routine Production of $^{99}\text{Mo}/^{99\text{m}}\text{Tc}$ Generator on Weekly Basis.
- Routine Dispensing of Bulk ^{131}I Solution on Weekly Basis.

2. R&D works

- Effect of Radioactive Concentration of $\text{Na}_2^{99}\text{MoO}_4$ on Chromatographic $^{99}\text{Mo}/^{99\text{m}}\text{Tc}$ Generator.
- R&D Work on $^{99\text{m}}\text{Tc}$ Radiopharmaceutical cold kits at RIPD.

3. Repair & Maintenance

- Routine Periodical Maintenance of the cGMP Compliant Computer Controlled Online $^{99}\text{Mo}/^{99\text{m}}\text{Tc}$ Generator Production Facility at RIPD and ^{131}I Production Plant
- Routine Periodical Maintenance of Non-pyrogenic Water Production Plant, Hot Air Sterilizer, and Steam Sterilizer.
- Routine Periodical Maintenance of the Evacuation Chamber for Vacuum Vial Preparation.
- Routine Periodical Maintenance of HPGe Detector
- Routine Periodical Maintenance of $^{99\text{m}}\text{Tc}$ Cold Kit Production Facility
- Routine Periodical Maintenance of Centralized HVAC System.

4. Manpower Development

Sl. No.	Title	Date	Place	No of Participants
a)	Conducted full theoretical and practical courses of MD Residency (Nuclear Medicine) course of BSMMU	July 2023 – June 2024	INST, AERE	10
b)	Industrial training program for the partial fulfillment of the requirement for the B.Sc. (Honours) Degree of the students of Jahangirnagar University, Savar, Dhaka	16 July – 26 August 2023	RIPD, INST	04

c)	Conducted two weeks training program for the students of the Department of Nuclear Engineering, Dhaka University.	14-25 January 2024	RIPD, INST	02

5. Seminar/Symposium/Conference/Workshop/Meeting Attended

Name of the Participants	Title of event	Organizer	Date	Place
R. Amin	National Safeguard Training Course	IAEA and BAERA	20 – 24 August 2023	BAERA
M. S. Reza	Bangladesh National Training Course on Preventive and Protective Measures against Insider Threats to Nuclear Material	Russian Federation	11 – 15 September 2023	Russian Federation
M. S. Reza	Training Course on PPR-2008 and Public Procurement Management-2024	TI, BAEC	28 January to 08 February	TI, AERE, BAEC
R. Amin	Seminar on Test Production, Quality Control and Biodistribution Study of Technetium-99m Cold Kits at Radioisotope Production Division.	INST, AERE	07 February 2024	Conference Room, INST, AERE
Dr. M. F. Waheed, Dr. Rabeya Akhter, R. Amin	27 th National Conference of SNMB, 2024	SNMB	8 March, 2024	Hotel InterContinental Dhaka
Dr. M. M. Rahman	The FNCA 2024 Study Panel (SP)	FNCA	11 March 2024	Tokyo, Japan

6. Collaboration Work (ADP/FCNA/ MEXT/IAEA/RCA/TC/S&T/CRP/In-house project, Universities, etc)

IAEA TC Project BGD/6/022: “Producing Therapeutic Radiopharmaceuticals”.

To produce and supply Therapeutic Radiopharmaceutical (^{177}Lu) to meet these isotopes' local demand is under implementation. Three scientific visits and one fellowship training have been completed.

7. Service Rendered

Number of services given to organization		Nature of service	Total number/ Amount (GBq)	Income (BDT) (Ref: Monthly report)
Under BAEC	Others			
NINMAS and 21 INMASs	Government Hospitals: NICVD, Dhaka & CMH, Dhaka Non- Government. Hospitals: LabAid, Dhaka; Evercare Hospital Dhaka; United Hospital Dhaka; Ahsania Mission Hospital, Dhaka, Enam Medical Hospital (Pvt.) Ltd., Savar, Dhaka	Supply of $^{99}\text{Mo}/^{99\text{m}}\text{Tc}$ generator	1227 nos. of $^{99}\text{Mo}/^{99\text{m}}\text{Tc}$ generators	171820000/-
NINMAS and 21 INMASs	CMH, Dhaka	Supply of ^{131}I radioisotope	4567.32 GBq of ^{131}I Oral Solution	41017000/-
Total				21,28,37,000/-

8. Lectures delivered

Scientists of this division conducted both theoretical and practical courses in the MD Residency (Nuclear Medicine) course of BSMMU.

Nuclear and Radiation Chemistry Division, INST

Objective

The objective of Nuclear and Radiation Chemistry Division (NRCD) is modification of materials to use in the fields of health, agriculture, water treatment and biodegradable packaging material by the application of nuclear technique especially gamma ray. Moreover, this division involved to measure the water quality of research reactor, provides analytical services to different institute of BAEC/other organizations of Bangladesh and study on environmental pollution of different matrix.

Programme

1. R&D Work(s)

1.1 Polyethylene Oxide (PEO), Xanthan Gum (XG) and Bentonite Clay (BC)

T.Ahmed, S. M. M. Hasnine, M. S. Rahaman, S. Sultana, M.J. Alam, M.M. Rahman, F. Khatun and Taslima Akter

This report describes how Polyethylene oxide (PEO) and two natural polymers, Xanthan Gum (XG) and Bentonite Clay (BC), were combined to create 3D porous hydrogels using Cobalt-60 source gamma radiation without crosslinker or initiator. The 3D porous hydrogel with enough active sites was confirmed by SEM and FTIR structural evaluations. In this study, we investigated the influence of BC concentration 0.25%–1% (w/v) on hydrogel gelation, swelling, crosslinking, and using the optimized hydrogel as an appealing adsorbent to remove dye molecules from dye-contaminated water. BC composition increased crosslinking formation and produced highly strong gel with low swelling capacity, indicating that BC feed ratio affected gelation and swelling.

1.2 Preparation of a Gamma Radiation Induced Hydrogel-Xanthan Gum, Acrylic Acid and 4-Styrenesulfonic Acid Na Salt and Its Optimization Study

S. M. M. Hasnine, T. Ahmed, M. S. Rahaman, S. Sultana, M. J. Alam, M. M. Rahman, F. Khatun and M. R. U. Chowdhury

This study investigates development of novel hydrogels with optimal characteristics for possible applications. The maximum gel fraction in radiation dosage optimization was 94.29% at 30 kGy, whereas the highest swelling ratio was 870% at 25 kGy. Observation of the swelling ratio led to the conclusion that the optimal radiation dose for additional research is 25 kGy. This study also looked at the effect of monomer composition and discovered that a hydrogel with the highest AAc concentration (15 wt. %) generated a highest swelling ratio of 1083.39% and a maximum gel fraction of 91.80%.

1.3 Removal of Methyl Orange Using a Radiation Grafted Novel Anionic Adsorbent

N. Rahman, S. Shahnaz, M. N. Sardar, A. R. Miah, M. H. Kabir

In present research work, γ -ray initiated grafting of glycidyl methacrylate (GMA) on non-woven polyethylene fabrics was followed by amine functionalization. Dependence of amination yield on degree of grafting was investigated. Extensive examinations on the adsorption of anionic dye methyl orange (MO) from aqueous solution by the functionalized GMA-g-non woven PE fabrics were conducted. Influence of variation of adsorption environment likely contact time, temperature, pH and initial metal ion concentration on MO adsorption aptitude was experimented. The optimal condition that provided maximum MO adsorption was identified to be contact time 48 h, initial metal concentration 500 ppm, pH 1.759 and temperature 80 °C. To understand the equilibrium between MO and the absorbent system Langmuir isotherm model was considered. Good fitting with Langmuir isotherm model suggested that MO adsorption was restricted to one molecular layer and the highest monolayer adsorption capacity calculated was 60.60 mg/g. The adsorption kinetics was analyzed using pseudo-first-order and pseudo-second-order models. The adsorption of MO was successfully inferred with pseudo-second-order model. The bonding between different groups and the surface morphology of the adsorbent was explored by FTIR and SEM Analysis. Successful desorption of MO followed by reuse of the regenerated adsorbent fabric revealed the future prospect of the reusable adsorbent.

1.4 Elimination of Uranium from Aqueous Solution Using Starch-Acrylic acid-Acrylamide Hydrogel Prepared by Radiation Technique

N. Rahman, S. Shahnaz, M. N. Sardar, A. R. Miah, M. H. Kabir

Fabrication of Starch-Acrylic acid-Acrylamide hydrogel was accomplished by the use of gamma rays from Co-60 source at room temperature. The adsorbent were characterized by IR. The prepared absorbent was utilized for absorption of uranium (VI) from aqueous solution. To investigate the effect of adsorption conditions on absorption capacity of the adsorption experiment were executed at changed contact time, pH, temperature and concentration of uranium (VI) solution. Absorption by the absorbent attains the equilibrium value after 5 hours. pH 3.7 was found optimum considering the highest absorption capacity. The absorption capacity shows highest value at 1000 ppm U(VI) concentration. The absorption capacity achieved under most favorable condition was 166.84 mg/g. Isotherm and kinetic models were used to interpret the U(VI) adsorption mechanism on the hydrogel. Results of desorption of U(VI) ions and reuse of the absorbent are hopeful. From the study it can be said that the starch-acrylic acid-acrylamide hydrogel absorbent have potential for uranium (VI) removal from contaminated water.

1.5 Removal of Copper Ions from Aqueous Solution Using Acrylic Acid and Diallyldimethylammonium Chloride Grafted Non-Woven Polypropylene Fabrics

M. N. Sardar, N. Rahman, S. Shahnaz, A. R. Miah, M. H. Kabir

This study focuses on the adsorption of hazardous Cu (II) ions from aqueous solution by applying modified polypropylene (PP) fabric as an adsorbent. Pre-irradiation technique was performed for grafting of diallyldimethylammonium chloride (DADMAC) and acrylic acid (AAc) onto the PP fabric. The monomer containing 11.25% DADMAC and 15% AAc in water was used. Graft yield at 30 kGy radiation dose was 350%. The influences of different parameters including contact time and initial metal ion concentration were investigated. By using UV-Visible spectrophotometer to measure the initial and final concentrations of metal ions in solutions, adsorption capacity was estimated.

1.6 Bioremediation of Tannery Effluents using Aquatic Plants; Water Lettuce (*Pistia stratiotes*) and Water Hyacinth (*Eichhornia crassipes*)

M.F. Alam, M.M. Rahman, K. Khatun, T.R. Tusher and S. Sultana

The study was conducted to evaluate the potentiality of water lettuce (*Pistia stratiotes*) and water hyacinth (*Eichhornia crassipes*) in the removal of pollutants from tannery effluents. This study involved a 15-day laboratory experiment using different treatments where efficiency was tested by analyzing the physico-chemical characteristics (pH, TDS, EC, DO, and BOD) as well as heavy metals (Cr, Ni, Zn, Cu, Mn, and Pb) concentrations of collected effluents from Hazaribag Tannery Area in Dhaka. All the parameters showed considerable rate of reduction for different treatments. The study concluded that both plants have the potential removal capability of pollutants including heavy metals from tannery effluents. Therefore, bioremediation is an innovative, environmental friendly, social benefit, and cost-effective option to remove environmental pollutants.

1.7 Comparison of Physical, Chemical, and Bacteriological Quality of Reactor Water and Normal Source Water

M.F. Alam, M.I. Hasan and M.Z. Hasan

This study investigates the crucial significance of coolant water quality in nuclear reactor systems and its impact on nuclear power plants' operational safety and efficiency. The coolant water, which is crucial for facilitating heat transfer and providing radiation shielding, directly influences the reactor's integrity and performance. The study methodically examines and conducts the physical, chemical, and bacteriological properties of reactor water with those of traditional water sources. The study conclusively demonstrates that the quality of the reactor coolant water is being upheld through a thorough analysis. The favorable quality of water in the primary coolant water is indicated by the physical, chemical, and bacteriological criteria including electrical conductivity, nitrate, chloride, total hardness, and total coliform count. Currently, the reactor primary water is being monitored for the existence of bacteria using total bacterial count.

1.8 Physicochemical Analysis of Few Locations of the Louhajang River & Their Adjacent Drinking Water in Bangladesh

M. Mahfujur Rahman, M. Ferdous Alam, M. A. Ali, S. A. Jolly, T. A. Chity, I. Chowdhury, S. Shahrin, S. Akter, S. Mia, M. Shalauddin, U. Salma, M. Das, M. K. Islam and S. Sultana

The present study was conducted at the five locations of the Louhajang River (LR) and their adjacent point's Drinking water (DW) as well as pond water (PW) samples to analyze the physicochemical parameters and quality assessments. The physical parameters of Louhajang River water and their adjacent Drinking water and pond water samples were pH (6.43-6.99), EC (870.1-1166 $\mu\text{S}/\text{cm}$), TDS (481.6-642.3 ppm), Salinity (0.38-0.54 ppt), Resistivity (0.857-1.14 $\text{K}\Omega\text{cm}$), Temperature (18.4-18.9°C); pH (6.16-6.67), EC (350.2-1641 $\mu\text{S}/\text{cm}$), TDS (192.4-901.4 ppm), Salinity (0.10-0.80 ppt), Resistivity (0.61-2.86 $\text{K}\Omega\text{cm}$) and Temperature (18.3-18.8°C) and pH (6.36-6.78), EC (103.7-301.1 $\mu\text{S}/\text{cm}$), TDS (56.04-166.6 ppm), Salinity (0.00-0.07 ppt), Resistivity (3.30-9.64 $\text{K}\Omega\text{cm}$), Temperature (22.6-23.9°C) respectively. The chemical analyses of the samples were exhibited as TA (42.4-54.0 mg/L), TH (608-720 mg/L), Cl^- (62.0682-94.1034 mg/L), Ca^{2+} (300-360 mg/L), NO_3^- (0.042-7.8 mg/L), SO_4^{2-} (3.2473-6.1828 mg/L), SiO_2 (38.203-43.383 mg/L), PO_4^{3-} (5.773-9.6795 mg/L) and TSS (0.002-0.8152 mg/L) for LR water samples, and TA (22.8-63.2 mg/L), TH (369.33-1360 mg/L), Cl^- (8.008-166.1826 mg/L), Ca^{2+} (70-382 mg/L), NO_3^- (3.7239-4.7514 mg/L), SO_4^{2-} (0.8503-5.9776 mg/L) and SiO_2 (28.919-42.074 mg/L), PO_4^{3-} (0.5469-4.1438 mg/L), TSS (0.008-0.079 mg/L) for DW samples and TSS (0.00798-1.654 mg/L) for PW samples. The analysis of the studied water quality parameters revealed that, at a few locations, the physicochemical parameters have been found in the limit for the standard values. In contrast, these parameters have exceeded at some locations, which can cause health hazards and environmental, agricultural & industrial complications.

2. Conference/Meeting attended

Name of the participant	Title of the event	Organizer	Date	Place
a) Md. Nabul Sardar	Nuclear Researcher Exchange Program by the Ministry of Education, Culture, Sports, Science and Technology	Government of Japan	September 25, 2023-February 9, 2024	Takasaki, Japan

	(MEXT)			
b) Dr. Nazia Rahman	Third Research Coordination Meeting	IAEA	23 to 27 October 2023	Takasaki, Japan
c) Shahnaz Sultana	Second Research Coordination Meeting (RCM) on Recycling of Polymer Waste for Structural and Non-Structural Materials by using Ionizing Radiation	IAEA	20 - 24 November 2023	Vienna, Austria
d) Dr. Md. Ferdous Alam	Technical Meeting on Good Practices and Challenges in Establishing, Implementing and Maintaining a Nuclear Material Accounting and Control Programme for Nuclear Security Purposes at Nuclear Facilities	IAEA	04 to 08 December 2023	Vienna, Austria
e) Dr. Salma Sultana	FNCA FY2023 Workshop on Radiation Processing and Polymer Modification for Agricultural, Environmental and Medical Applications	FNCA	23-26 January, 2024	Manilla, the Philippines.
f) Mohammad Mahfujur Rahman	International Conference on Physics – 2024	Bangladesh Physical Society	9 – 11 May 2024	Dhaka, Bangladesh.
g) Dr. Nazia Rahman	International Conference on Physics – 2024	Bangladesh Physical Society	9 – 11 May 2024	Dhaka, Bangladesh.
h) Dr. Md. Ferdous Alam	International Conference on Physics – 2024	Bangladesh Physical Society	9 – 11 May 2024	Dhaka, Bangladesh.
i) Dr. Nazia Rahman	First Project Coordination Meeting RAS1031 - Reutilizing and Recycling Polymeric Waste through Radiation Modification for the Production of Industrial Goods – Phase 2	IAEA	17 – 31 May 2024	Shanghai, China

Health Physics and Radioactive Waste Management Unit, INST

Objective

Since its inception, the Health Physics and Radioactive Waste Management Unit (HPRWMU) has played a vital role in protecting human health and the environment from the harmful effects of ionizing radiation associated with radiation sources and radioactive waste through radioactivity monitoring, radiation protection and control and radioactive waste management. This unit is conducting its R&D and regular activities in the following areas:

- Radiation Protection (RP): Providing routine and emergency radiation protection services in all radioactive source using establishments and radiation generating/producing facilities/equipment in the country.
- Environmental Radiation Monitoring (ERM): Environmental radiation/radioactivity monitoring/assessment in different environmental matrix (Soil, Sediment, Sand, Water, Milk, Food stuffs, Vegetation, building material, Air etc.) throughout the country aiming at the assessment and control of radiation exposure to occupational workers and the general public. This work is important to define the appropriate safety limits and code of practices

- **Radioactive Waste (RW) Management:** Working on safe management of RW and radiation source (RS) including their ultimate disposal. Collection, segregation, transportation, processing, conditioning and interim storage services of solid and liquid radioactive wastes and disused sealed radioactive source (DSRS) are provided to all radioactive source-using establishments (e.g., health sectors, industrial sectors, research, agriculture etc.) in the country. A central radioactive waste processing and storage facility (CRWPSF) has been established in 2005 to process and safe storage of radioactive waste on interim-basis until final disposal.
- **Dosimetry and calibration:** Performing calibration and standardization of radiation measuring/monitoring equipment. Performing external and internal radiation dosimetry including Quality Assurance (QA). A Secondary Standard Dosimetry Laboratory (SSDL) has been established in 1988 as a part of IAEA/WHO SSDL network to ensure that the calibration conforms to internationally accepted standards.

HPRWMU is equipped with the necessary equipment and trained personnel to do the above jobs.

1. R & D Work(s)

1.1 Radiological Assessment of NORM/TENORM Resulting from Fertilizer Production Processing and their Environmental and Health Effects.

K. Asaduzzaman, M. Begum, S. Paul, M.F. Uddin, M.A. Haydar and M.A. Rahman

Non-nuclear industries such as the fertilizer industry use raw material containing significant levels of natural radionuclides; the processing of these materials can expose the environment, workers and people living near such sites to radiation levels well above the natural background. Consequently, increasing attention has been paid to the many non-nuclear industries, which have the capability for low-level but consistent exposure to ionizing radiation. Such industries are capable of generating critical group or collective exposure or both; doses can be delivered both to plant workers and to populations living in the neighborhoods of plants. Fertilizer and its by-products and wastes are among the significant sources of naturally occurring radioactive materials (NORMs). These materials may be enhanced to high levels due to technological and human activities, which are called technologically enhanced naturally occurring radioactive materials (TENORMs). Thus, the average radioactivity of these radionuclides sometimes exceeds the exemption level of 10 000 Bq kg⁻¹, which is recommended by the IAEA's safety standards. TENORMs in the fertilizer industry may generate greater radioactivity levels, which eventually represents potential environmental and health risks. This will require continuous attention by monitoring and surveillance during routine processes in the fertilizer industry. In the present study, to assess the impact of a urea fertilizer factory on the environment and public health, the environmental pollution impact was analyzed by determining the NORM/TENORM concentrations of the radionuclides and radiological hazard indices in soil, water and fertilizer samples around a fertilizer factory complex. Such information will lead to an accurate dosimetric evaluation of the risk of human exposure due to enhancements of TENORM (technologically-enhanced naturally occurring radioactive materials) levels. Moreover, their environmental and health hazards in different regions of the world are discussed.

1.2 Countrywide Background Gamma Radiation and Environmental Radioactivity Monitoring During the Pre-Operational Phase of Rooppur Nuclear Power Plant (RNPP) - continuation of previous work.

K. Asaduzzaman, M. Begum, S. Paul, M.F. Uddin, M.A. Haydar, M.A. Rahman, M. Ahmed, B.C. Sutradhar, M.H. Rahman and A. Rahim.

Background gamma radiation refers to the naturally occurring ionizing radiation that is present in the environment from cosmic sources, terrestrial materials, and radioactive elements. This background level provides a baseline against which increases in radiation can be measured, helping to assess changes due to human activities or technological operations. Background gamma radiation monitoring is integral to both regulatory compliance and the protection of human health and the environment in the context of nuclear

power development. It plays a crucial role in the pre-operational phase of Rooppur nuclear power plant (RNPP) to establish baseline environmental conditions and ensure safety standards are met. This monitoring involves systematically measuring and analyzing gamma radiation and radioactivity levels in the vicinity of the RNPP site to detect any pre-existing radiation that could impact the future operations of the power plant. By comparing these baseline measurements with ongoing data collected once the plant is operational, operators can identify any deviations that may indicate potential radiological concerns. Considering this perspective, gamma radiation doses were measured at the surface level (5cm above the ground) and 1m above the ground level at the eight districts of central part of the country as a part of countrywide background radiation mapping program. The average surface dose level varied from 0.06 ± 0.01 to 0.11 ± 0.01 $\mu\text{Sv/h}$. While, the average dose level at 1 m above the surface/ground ranged from 0.056 ± 0.004 to 0.10 ± 0.01 $\mu\text{Sv/h}$. The dose levels were almost uniform over the area surveyed and no 'hot spot' was observed. Besides, Soil and ground water samples were collected for the assessment of natural and anthropogenic radionuclides distribution and its concentration in this area. This process not only helps in validating the efficacy of the plant's radiation shielding and safety protocols but also reassures the public and regulatory bodies of the plant's commitment to maintaining a safe and controlled environment.

1.3 Cleaning Radioactively Contaminated Land: Soil Remediation for Cs-137 Contamination.

M.I. Ali, K. Asaduzzaman, M. Begum, S. Paul, M.F. Uddin, M.A. Haydar, H.M. Jamil, M.A. Rahman, M. Ahmed, B.C. Sutradhar, M.H. Rahman and A. Rahim.

Before the establishment of Central Radioactive Waste Processing and Storage Facility (CWPSF), the institutional radioactive wastes were temporarily stored at a small brick-built room adjacent to the west side outer fence of CRR building. It is known from a PhD thesis titled "An investigation on the uptake behavior of Cesium-137 in some fresh water fish species commonly consumed in Bangladesh" published in 1989 that an experiment was conducted by mixing Cs-137 with water in plastic drum under the supervision of a scientist named Md. Abdul Malek of HPRWMU, INST, AERE. The plastic drum filled with Cs-137 contaminated water was stored on an interim basis in that brick-built room. The Cs-137 contaminated water-filled plastic drum was broken down and contaminated the land in front of that room. The boundary of the contaminated site was demarcated and covered with a concrete slab. The cleanup of radioactively contaminated land, particularly those tainted with Cs-137 (Cs-137), poses significant environmental and health challenges. Cs-137, an anthropogenic radioisotope with a half-life of approximately 30 years, can persist and have high mobility in soil. Radiation survey, soil sample collection, characterization and evaluation, soil evacuation, storage and transportation techniques were analyzed, evaluating their efficacy, cost, and environmental impact were assessed. Our findings underscore the importance of tailored approaches in achieving safe and sustainable remediation of Cs-137-contaminated lands.

1.4 Characterization and Radiological Risk Assessment of NORMs (Naturally Occurring Radioactive materials) in the Gas fields of Bangladesh.

M. M. H. Bhuiyan and S. Paul

Radionuclides occur naturally in the environment and are present in most materials in earth. The accumulation of natural radionuclides and the increase in their radioactivity to excessive levels will lead to health hazards and environmental damages. In Bangladesh most of the NORMs (Naturally Occurring Radioactive materials) are produced from expansion of gas exploration activities. therefore, carrying out studies, evaluations, and characterization and risk assessments in the most significant gas process plants with the possibility of excessive accumulation of NORMs in their various processes is inevitable to protect occupational health of employees and stakeholders and prevent the pollution of environmental resources including soil, water and air. Under this project 2023-2024, (ID - SRG-236617) funded by MoST (Ministry of Science & Technology) NORMs samples were collected from different gas fields of Bangladesh and characterization and risk assessment are in progress.

1.5 Radiation Safety and Shielding Evaluation of Newly Installed Medical LINAC Facility in Bangladesh

M. F. Uddin, M. Begum, M. Ahmed, K. Asaduzzaman.

Medical linear accelerator (Linac) is widely used for radiotherapy purposes which is one of the cancer radiation therapy modalities. When a Linac is being installed, an initial survey is required during the first beam and a complete shielding survey must be carried out after the Linac has been operational and calibration completed. Based on the detailed survey report, the facility license is issued. Worldwide several organizations provide various recommendations regarding shielding design and radiation safety issues. The purpose of this paper is to show how to assess or validate the radiation safety and shielding status of the newly installed Linac facility in Bangladesh. In this study, one of the Linac facilities in Dhaka city has been chosen which was installed in 2021. The dose rate meter RadEYE PRD and tele survey meter TELE-STTC are used for x-ray/gamma-ray dose measurement and REM 12/4 Count Ratemeter for neutron measurement. A maximum photon dose of $5.56 \mu\text{Sv h}^{-1}$ was observed at a gantry angle of 90° along the center front of the door, while a maximum neutron dose of $1 \mu\text{Sv h}^{-1}$ was found at three different locations. The obtained results are in line with the recommendations by controlling organizations. This study found that the Linac can be operated safely for both conventional and IMRT modes, and the same shielding procedure can be followed all over the country for the same Linac setting.

1.6 Neutron Spectrometry and Dosimetric Assessment at SSDL of HPRWMU, INST, AERE, BAEC

Mahiuddin Ahmed, B. N. Sattar, K. M. MahabubMorshed, K. Fatema, H. M. Jamil, M. Shamsuzzaman and M. M. H. Bhuiyan

The development and experimental standardization of neutron fields conventionally arranged for detector calibrations used for radiation control and environmental measurement. In 1934, the experimental verification of controlled neutron fission by a group of scientists led by Enrico Fermi opened the door to new research and paved the way for the atomic age. Since then, the neutron as a particle or beam has been extensively and reliably used in the fields of material characterization, biological research, energy research, environmental research, and astrophysics and cosmology. Among the available different neutron sources, the Secondary Standard Dosimetry Laboratory (SSDL) has installed isotopic sources: Americium-Beryllium ($^{241}\text{AmBe}; \alpha, n$ source) and Californium-252 (^{252}Cf : spontaneous fission); capable of generating panoramic neutron beam with an emission rate in the order of 10^7 n s^{-1} . In this facility, the recent addition of a portable Nested Neutron Spectrometry (NNS) system enhanced the capability of SSDL to characterize the neutron fields of reactors, accelerators, and isotopic sources. In this study, the energy spectrum of the neutron field of SSDL's neutron irradiator has been studied for the case of High-Density Polyethylene (HDPE) moderated and unmoderated/bare neutron fields. Assessed results were compared with the neutron spectra presented in ISO 85291-1 and a good agreement was observed. The ambient dose equivalent rates for each spectrometric measurement case were also calculated by folding these spectrums (energy differential neutron flux) with fluence to the dose equivalent rate conversion coefficient suggested in the International Commission on Radiological Protection (ICRP) Publication-74.

1.7 Enhanced Radiation Attenuation Property of Tungsten-Polytetrafluoroethylene Composite, Fabricated Using Powder Metallurgy Technique.

M. Ahmed and M.M.H. Bhuiyan

The growing utilization of technologies that rely on radiation is elevating the risk of radiation hazards and this ultimately necessitates the development of enhanced shielding materials to safeguard both people and the environment. Polymers, for example, have promising mechanical, electrical, thermal, and multifunctional properties except for the poor stopping power to electromagnetic wave radiations due to their lower atomic mass. Furthermore, composites comprised of polymers and high-atomic-number fillers may exhibit the desired properties like lightweight, mechanical flexibility, easy processing, and better shielding against radiation. In this research, the composite was made by powder metallurgy technique where the PTFE polymer and Tungsten metal ratio was 1:0 to 1:2.5. Here, the radiation shielding ability of the PTFE control and Tungsten-based composites was assessed by using a collimated beam of gamma (γ) radiation emitting from 10 Ci Cs-137 radioisotope at Secondary Standard Dosimetry Laboratory of Bangladesh Atomic Energy Commission. The shielding efficiency was characterized by LAC (Linear Attenuation Coefficient), HVL (Half Value Layer), MAC (Mass Attenuation Coefficient), TVL (Tenth Value Layer), SVL (Sixteenth Value Layer), and percentage of radiation attenuation. It is found that 1:2.5 the polymer and metal ratio represents

51.94% radiation attenuation, 1.02cm HVL, 3.422cm TVL, and 4.121cm SVL results which is content composite experienced relatively good attenuation performance against γ -ray than other studied composites. Further study with X-ray and higher energetic γ -ray will be carried out to assess the versatility of the shielding capacity of the composites.

1.8 Assessment of Ambient Dose Equivalent and Shielding Effectiveness at the Neutron Calibration Facility at SSDL of HPRWMU, INST, AERE, BAEC.

M. Ahmed, M. Shamsuzzaman and M. M. H. Bhuiyan

Neutron dosimetry is necessary for the monitoring of radiation exposure, not only in the nuclear industry and related activities but also in the growing number of neutron-producing facilities, so new techniques and devices are continuously developed and improved. The purpose of this research is to offer comprehensive guidance for individuals conducting experiments involving ^{252}Cf and $^{241}\text{Am-Be}$ neutron sources at the Secondary Standard Dosimetry Laboratory (SSDL), Atomic Energy Research Establishment, Ganakbari, Savar, Dhaka. Throughout the experiment, neutron doses were measured at various points within the facility. The he-3 detector was utilized as the neutron detector to ascertain the occupational safety required for the experiment. To assess the ambient dose equivalent in the facility, detectors are positioned at 13 locations, including, surrounding the bunker and rooftop. Based on the assessment of the source room shielding it is found that the side walls including the barrier in the control room are performing perfectly, however in three points on the roof-top, the dose rates were recorded higher than the public exposure limit. Some obvious suggestions include limiting public access to the rooftop when the neutron sources are in an exposure condition and reinforcing the roof's shielding capacity by adding a 19 cm thick layer of high-density polyethylene or a 28 cm thick layer of ordinary concrete.

1.9 Study on Optically Stimulated Luminescence (OSL) in Therapeutic Photon Beam Dosimetry

H.M. Jamil, K. M. M. Morshed, K. Fatema, B. N. Sattar, M. M. H. Bhuiyan and M. S. Rahman

The study aims to evaluate and compare the performance of dosimetric methods in the context of therapeutic photon beams commonly utilized in clinical radiation oncology. The research focuses on dosimetric measurements employing BeO based Optically Stimulated Luminescence (OSL), an excellent dosimeter for in vivo dosimetry. Another objective of this study is inter detector response of three different ionization chambers (IBA FC65G, PTW TN30013, A19 XAQ110103) for different field sizes (5x5 – 20x2 cm) according to TRS 398 and correlate the dose response of 20 OSLDs for different field sizes in clinical range. For dose range 0.50 Gy-2.50 Gy Inter-detector average variation in OSLD response was found within 2.86%. The dose linearity was investigated between dose ranges from 0.5–2.5 Gy. The dose response curve was found to be linear until 2.5Gy for individual 20 OSL dosimeter. OSLD and ionization chamber was used for irregular field dosimetry and OSLD response shows good agreement with the ionization chamber (PTW TN30013 and A19). The average deviation for field size is 1.26% for PTW TN30013 and 1.30% for A19. The comparative analysis between OSL facilitates informed decision-making regarding the selection of dosimetric techniques based on specific clinical scenarios. Ultimately, this research will enhance the accuracy and reliability of absorbed dose measurements with various detector for therapeutic photon beams, thereby improving the overall quality and safety of radiation therapy for cancer patients.

1.10 Performance Evaluation of Ionization chambers for Small Field Dosimetry in Blue Phantom2 at the 60-Co Teletherapy Facility of SSDL of HPRWMU, INST, AERE, BAEC

H.M. Jamil, K Fatema, K. M. M. Morshed, B. N. Sattar, M. Shamsuzzaman, M. M. H. Bhuiyan and M. S. Rahman

In radiotherapy radiation fields are characterized between $4\times 4\text{ cm}^2$ and $25\times 25\text{ cm}^2$, and field size below $4\times 4\text{ cm}^2$ being considered small fields. Accurate dosimetry for small fields is challenging due to the loss of lateral electronic equilibrium. Several procedures for dosimetry have previously been created by several international organizations, such as the IAEA (TRS-277, TRS-381, TRS-398), AAPM (TG-21, TG 51), and DIN-6800-2 for absorbed dose to water measurement of photon and electron beams over $4\times 4\text{ cm}^2$ field sizes. The current work aims to objectively assess the dosimetric performance of several types of detectors (Farmer chamber type FC65-G, Semiflex chamber type 31010, PinPoint 3D chamber type 31022, Diode E type 60017,

microDiamond type 60019) in small-field radiation for the 60-Co Teletherapy beam. The dosimetric properties such as beam profiles, including absolute dosimetry, PDD, symmetry, flatness, and penumbra, were studied for field sizes of 10×10, 5×5, 4×4, 3×3, and 2×2 cm² for five distinct detectors. Following several experimental investigations, it is evident that different types of detectors have their own perks, but the microDiamond solid-state detector has greater advantages over other detectors for small field dosimetry due to its small sensitive volume, flat energy response, small physical size, negligible directional dependence, high sensitivity, and resistance to radiation damage. The analysis would be helpful in defining future protocols for the development of small-field dosimetry.

1.11 Characterization of Neutron Beam of the Neutron Irradiator (NI-03) at SSDL of HPRWMU by Experimental Measurement and Monte Carlo n-Particle (MCNP) Simulation

H. M. Jamil, B. N. Sattar, K. M. M. Morshed, K. Fatema, M. Shamsuzzaman, M. M. H. Bhuiyan and M. S. Rahman

Calibration of neutron monitoring devices in a lab necessitates knowledge of neutron field properties, which can be obtained through experimental or computational measurements of neutron flux and other parameters like free field dose equivalent, absorbed dose rate, and various correction factors like geometrical correction, air attenuation, and room scattering. A neutron irradiator with ²⁵²Cf and ²⁴¹Am-Be sources was utilized in the current investigations, which took place at the Secondary Standard Dosimetry Laboratory of the Bangladesh Atomic Energy Commission. Experimental measurements and simulations using the Monte Carlo Neutral Particle (MCNP) transport code were used to study the spectroscopic and dosimetric parameters of the two sources. Using the Nested Neutron Spectrometer (NNS) and MCNP simulation, spectroscopic measurements were taken for both unmoderated and HDPE-moderated sources. The MLEM and STAY'SL algorithms were used to unfold all measurements in NNS. In each instance, the energy distribution between the experimental and simulated results is remarkably concordant. In order to examine dosimetric quantities, MCNP simulation and two neutron survey meters (BERTHOLD 6411D Nr 1089 and BERTHOLD 6411D Nr 1090) were utilized. In the MCNP simulation, the observed dose rate at 100 cm from the ²⁵²Cf source was 912.078 µSv/h, while the theoretically calculated value for that distance is 791.245 µSv/h. In the neutron survey meters, the observed dose rate was 942.724 µSv/h. The two survey meters recorded the dosage rate at 100 cm for the ²⁴¹Am-Be source as 148.788 µSv/h and 151.340 µSv/h, respectively. The MCNP simulation yields a value of 112.724 µSv/h, but the theoretically calculated value for that distance is 128.827 µSv/h. Spectroscopic data calculated with NNS and dosimetric data calculated with survey meter both have their share of uncertainty, too. There are measurement-related errors introduced by the MCNP simulation as well.

2. Manpower Development:(Training/Fellowship/Workshop/Meeting)

2.1 Attend in Training/Fellowship/Workshop/Meeting

Sl. No.	Title of the program	Date	Place	Number of participants
1.	Application Seminar-Workshop on Operation and maintenance of Neutron Calibration System and Beam Standardization program	8-18 August 2023	VF, Czech Republic	04
2.	Workshop on "NeutronMetrology".	9 - 17 August 2023	Laboratory of Neutron Metrology, Czech MetrologyInstitute, Czech Republic	04
3.	National Safeguards Training Course	20-24 August 2023	BAREA, Dhaka	~30
4.	Bangladesh National Training Course on Preventive and Protective Measures against Insider Threats to Nuclear Material, Obninsk	11 - 15 September 2023	Russian Federation	-

5.	Consultancy Meeting to Discuss and practice Guidelines for the Specific Roles and Responsibilities of Occupational Radiation Protection Appraisal Service	09-13 October 2023	Philippines	-
6.	FNCA 2023 Workshop on Radiation Safety and Radioactive Waste Management project.	7-9 November 2023	Malaysian Nuclear Agency, Malaysia	21
7.	Advanced Instructor Training Course on Nuclear and Radiological Emergency Preparedness	14-24 November 2023	Nuclear Human Resource Development Centre, JAEA, Tokaimura, Japan	20
8.	Workshop on Expert Mission on Completing Self-assessment of Emergency Arrangements for Preparedness and Response Information Management System (EPRIMS)	03-14 December 2023	BAERA, Dhaka	~30
9.	Expert Mission on Emergency Preparedness Review (EPREV) Preparatory Meeting under IAEA TC Project (EX-BGD9019-2206278)	27-28 February 2024	BAERA, Dhaka	~30
10.	Fundamentals of Non-Destructive Assay for International Safeguards.	February 26 - March 1, 2024	Los Alamos National Laboratory, New Mexico, USA	16
11.	Regional Workshop on Development of National Radiation Emergency Plan (NREP)	25- 29 March, 2024	Thailand	-
12.	IAEA Technical Meeting on Global Progress in Developing Geological Disposal Solutions.	16 – 18, April 2024	Virtually	40
13..	Interregional meeting on new possibilities for reuse and recycling of SRS and DSRS.	13-17 May 2024	Nicosia, Cyprus	49
14.	Borehole Disposal for a DSRS inventory – Outcomes of an IAEA coordinated research project (Online)	12 June 2024	Virtually	-
15.	Technical Meeting on Enhancing Institutional Radioactive Waste Management by Promoting Innovation, and Overcoming Challenges	24–28 June 2024	IAEA Headquarters, Vienna, Austria.	22

3. Oral/Poster Presentation in Seminar/Symposium/Conference(National and International)

Name of the Participant	Title of the oral/ poster presentation	Title of the event	Organizer	Date	Place
Engr. Shampa Paul	Nuclear and Radiological Emergency Preparedness	12 th Follow-up Training Course	BAEC	September 2023	Training Institute, AERE, Savar, Dhaka

Dr. Md. Mosharrof Hossain Bhuiyan	FTC on Nuclear and Radiological Emergency Preparedness Course at BAEC-2023.	FTC on Nuclear and Radiological Emergency Preparedness	BAEC	11 September 2023	Training Institute, AERE, Savar, Dhaka
Dr. Khandoker Asaduzaaman	NORM/TENORM management in Bangladesh	FNCA 2023 Workshop on Radiation Safety and Radioactive Waste Management Project(RSRWM).	NSRA, Japan and Malaysian Nuclear Agency, Malaysia	7-9 November 2023	Malaysian Nuclear Agency, Malaysia
Dr. Mahfuza Begum	Radiation Monitoring, Radioactive Contamination and Detection Procedures	Training course on radiation protection for radiation workers and RCOs of BAEC, Medical Facilities & Industries.	BAEC	02 June 2024	Training Institute, AERE, Savar, Dhaka
Dr. Md. Mosharrof Hossain Bhuiyan	Biological Effect of Ionizing Radiation	Training course on radiation protection for radiation workers and RCOs of BAEC, Medical Facilities & Industries.	BAEC	02 June 2024	Training Institute, AERE, Savar, Dhaka
Dr. Md. Mosharrof Hossain Bhuiyan	Duties and Responsibilities of RCO	Training course on radiation protection for radiation workers and RCOs of BAEC, Medical Facilities & Industries.	BAEC	02 June 2024	Training Institute, AERE, Savar, Dhaka
Dr. Khandoker Asaduzaaman	Management of Institutional and Industrial Radioactive Waste in Bangladesh Challenges and Prospects	Technical Meeting on Enhancing Institutional Radioactive Waste Management by Promoting Innovation, and Overcoming Challenges	IAEA	24-28 June 2024	IAEA Headquarters, Vienna, Austria.
Dr. Khandoker Asaduzaaman	Measurement of Radiation caused by radioactive substances discharged	Training Course on Radiation Protection for Radiation Workers and RCOs of BAEC, Medical Facilities & Industries	Training Institute, AERE, Savar, Dhaka	5 June, 2024	Training Institute, AERE, Savar, Dhaka

M.M.M.H.Bhuiyan and Md Mahfuzur Rahman	Development and Characterization of Radiation Shielding Materials Based on Indigenous Raw Materials (Project ID # SRG-226623)	2023-2024 Special Allocation Research Project: Results and Application” 2 nd Seminar, MoST	MoST	25-06-2024	Bangladesh Reference Institute for Chemical Measurement (BRICM), BCSIR Campus
Mahiuddin Ahmed	Neutron Spectrometry and Dosimetric Assessment at SSDL, BAEC	International Conference on Physics - 2024	Bangladesh Physical Society	9-11 May 2024	Atomic Energy Centre Dhaka, Bangladesh.

3. Stakeholder Meeting

Sl. No.	Title of the program	Date	Place	Number of participants
01	SSDL, HPRWMU Stakeholders Meeting	27-03-2024	Online Zoom Platform	30

3. Collaboration work/MoU (ADP/FNCA/MEXT/FTC/IAEA/RCA/TC/S&T/CRP/ In-house project/Universities, etc)

- FNCA project on Radiation Safety and Radioactive Waste Management.
- Establishing and Enhancing National Infrastructure for the Management of Disused Sealed Radioactive Sources, Radioactive Wastes and Naturally Occurring Radioactive Material (RAS9097).
- Special allocation project of Ministry of Science and Technology, 2023-2024: Identification and Assessment of Potential Regions for the Disposal of Low and Intermediate Radioactive Waste (LILW) in Bangladesh.
- Special Allocation Research Project, MoST, Title “Characterization and Radiological Risk Assessment of NORMs (Naturally Occurring Radioactive materials) in the Gas fields of Bangladesh” 2023-2024.

4. Service Rendered

Sl. No.	Name of service provided	Number/quantity of sample/patient/service	Revenue income
i.	Radiation Survey	97	1,53,500/-
ii.	Calibration and Standardization	165	8,00,000/-
iii.	Radioactive source/waste interim storage	07	7,44,157/-
iv.	Environmental sample analysis	327	-

5. Repair & Maintenance, Renovation works, etc.

Shelf for Storing Radioactive Waste Drums

Two shelves have been designed for storing radioactive waste drums. These shelves were built with mild steel and installed in the interim waste storage room of CWPSF.

Reactor Physics and Engineering Division, INST

Objective

The program of the division is to conduct R&D activities using modern methods for the computational analysis of nuclear reactors, with particular emphasis on reactor physics, design and safety. Here, we procure and implement computer codes related to reactor engineering and nuclear data processing with international

collaboration. The ultimate objective of the division is to support the development of infrastructure for nuclear power program to meet the ever increasing demand of electricity.

Activities

Neutronics and Thermal Hydraulics calculations are needed for efficient utilization and safe operation of nuclear reactor. In this regard modeling of TRIGA and VVER type reactor are going on. The division also supports Nuclear Engineering study program of different local universities.

1. R & D work(s)

Description: RPED is engaged in developing and transferring technology/computer codes for overall design, analysis, in-core fuel management and safety studies of nuclear reactors. The following on-going research projects are highlighted to reflect the activities of the division:

- Nuclear engineering and nuclear data processing
- Radiation shielding analysis of radiation facility Japan
- Neutronics analysis of nuclear reactors
- Thermal hydraulics and Safety studies of nuclear reactors

2. Seminar/Symposium/Conference/Workshop/Scientific Visit/Meeting Attended

Sl. No.	Name of the Participant	Title of the event	Organizer	Date	Place
a)	Dr. Mohammad Abdul Motalab	Development of Neutronic and Thermal-Hydraulic Coupled Computational Methodologies for Research Reactor Including Analysis and Treatment of Uncertainties	IAEA-CRP	24-25 October 2023	RPED, INST
b)	Dr. Badrun Nahar Hamid	Advance Instructor Training Course (AITC) JFY-2023	MEXT-JAEA	14-24 November 2023.	Japan
c)	Dr. Mohammad Abdul Motalab	Second Research Coordination Meeting on Development of Neutronic and Thermal Hydraulic Coupled Computational Methodologies for Research Reactor Including Treatment of Uncertainties	IAEA - CRP	19-23 February 2024	Barioche, Argentina
d)	Dr. Badrun Nahar Hamid Dr. Mohammad Abdul Motalab Md. Altaf Hossen	PLTEMP/ANL Code Training	IAEA-CRP	April 2024	RPED, INST (On line Training)

3. Collaboration work/MoU (ADP/FNCA/MEXT/FTC/IAEA/RCA/TC/S&T/CRP/In-house project, Universities, etc)

- i. Two lectures delivered in Reactor Engineering Course BAEC (RECB-II)/2023 as a Part of FTC on December, 2023
- ii. IAEA- CRP Project: Development of Neutronic and Thermal-Hydraulic Coupled Computational Methodologies for Research Reactor Including Analysis and Treatment of Uncertainties, (F12028)

Tandem Accelerator Facilities Division, INST

Objective

The inauguration of the 3 MV Tandem Accelerator at the Atomic Energy Research Establishment (AERE) campus in 2011, under the auspices of the Bangladesh Atomic Energy Commission in Savar, marked a pivotal moment in the advancement of nuclear research. This state-of-the-art facility was established to serve as a catalyst for scientific exploration across various domains. It not only delves into the complexities of fundamental nuclear phenomena but also provides indispensable data for a wide array of applied sciences, including crucial environmental pollution studies which will facilitate Bangladesh governments PP2041 environmental management strategy. Within this dynamic framework, established analytical techniques like Particle Induced X-Ray Emission (PIXE) and Rutherford Backscattering Spectrometry (RBS) find practical application, shedding light on material composition and structure. Additionally, the facility's advanced capabilities have reignited interest in exploring nuclear reactions using modern detector technologies and sophisticated electronics systems, heralding a new era of refined fundamental studies with profound implications. From the beginning the facility and the Tandem accelerator has been designed in such a way so that it is possible to incorporate AMS easily to the facility.

The main objective of this division is to keep the complex accelerator system operational by regular repair and maintenance and provide ion beam for doing research. The other objectives are:

- To train manpower in advanced nuclear technology
- To offer analytical services, encompassing both qualitative and quantitative analysis of elements present in various types of samples.
- To investigate nuclear reactions through ion beam irradiation.
- To provide ion beams to students and other researchers, enabling them to pursue research in nuclear physics, material science, and environmental science, etc.
- To incorporate Accelerator Mass Spectrometry (AMS) for age determination and other non dating application such as Hydrology, Agriculture, Geology, Environmental etc.
- To seek new utilization of the accelerator for the society (seed mutation, cancer therapy, etc.)

1. R&D work(s)

1.1 Nuclear Reaction Cross Section for the Production of ^{51}Cr and $^{52,54}\text{Mn}$ in the Interaction of Deuteron with Iron

M. M. Hasan, M. S. Uddin, A. K. M. Shafiq Ullah, M. Hasan and M. A. Shariff

In nuclear facilities, iron is used as a structural material. It is a crucial target material for the production of radioisotope. So, there are considerable interest for theoretical studies and practical applications of activation cross sections of charged-particle induced reactions on natural iron. The cross sections of deuteron-induced reactions on $^{\text{nat}}\text{Fe}$ were measured by stacked-foil activation experiments from 15 to 35 MeV deuteron beam energy. Two stacks of Fe targets were irradiated with deuterons of primary energies 33 MeV and 40 MeV, for 30 and 45 min, respectively. In both irradiation, the beam current was kept constant at about current of 100 nA. The radioactivities produced in both the target and monitors were measured non-destructively by a HPGe γ -ray detector associated with necessary electronics and acquisition software. The available experimental databases of the reaction products ^{51}Cr , ^{52}Mn and ^{54}Mn were extended and compared with the nuclear model calculations using the TALYS code. The model calculations reproduce our measured data after a careful choice of the input model parameters. Some information could also be obtained on competition between the emission of multinucleons and a bound α -particle.

New cross-section data sets of the processes $^{\text{nat}}\text{Fe}(d,x)^{51}\text{Cr}$, $^{\text{nat}}\text{Fe}(d,x)^{52}\text{Mn}$ and $^{\text{nat}}\text{Fe}(d,x)^{54}\text{Mn}$ in the deuteron energy range of 15 to 35 MeV were acquired. They should help to remove some of the existing discrepancies in available experimental databases of the above reaction products.

1.2 Integral Cross Sections of Fast Neutron Induced Reactions in a TRIGA Reactor

M.S. Uddin, M. M. Uddin, M. M. Hasan and M. A. Shariff

The fast neutrons in the energy range of 0.5 to 20 MeV present in the reactor core are of particular interest for various applications. These include the production of special radionuclides with high specific activity, radiation safety analysis, and integral tests of excitation functions for certain neutron threshold reactions. Compared to radiative neutron capture, the (n,n'), (n,p) and (n, α) reactions are generally less significant for isotope production due to their relatively low cross sections and the lower flux of higher-energy neutrons at typical irradiation facilities of a TRIGA reactor. However, these nuclear reactions may still substantially contribute to the yield of radioisotopes in the reactor core where the integral fast-neutron flux is comparable to the thermal-neutron flux. In view of the above considerations, we planned to measure the integral cross sections of the fast-neutron nuclear reactions on strontium in the mixed radiation field of the TRIGA reactor.

A new measurement of the integral cross sections for the reactions $^{84}\text{Sr}(n,p)^{84}\text{Rb}$, $^{86}\text{Sr}(n,p)^{86}\text{Rb}$ and $^{87}\text{Sr}(n,n')^{87\text{m}}\text{Sr}$ in the neutron field from the energy 0.5 to 20 MeV at TRIGA reactor was performed. The results obtained in this work are the first one measured at a TRIGA reactor. The measured data were compared with the values for a pure ^{235}U fission spectrum. The discrepancies between the recommended values for the pure fission spectrum and our measured values can be attributed to differences between the TRIGA neutron spectrum and the pure fission spectrum below 2 MeV. The results of this work are valuable for testing the evaluated excitation functions in various data libraries, including ENDF/B-VIII.0, ROSFOND-2010, JEFF-3.3, JENDL-5, and TENDL-2021. Our integral measurements are generally consistent with the integrated values from these libraries. For a few investigated reactions, the evaluated data files appear to need improvement.

2. Manpower Development (Training/Fellowship/Workshop/Meeting)

2.1 Attend in Training/Fellowship/Workshop/Meeting

Sl. No.	Title of the program	Date	Place	Number of participants
a) Dr. Md. Asad Shariff	Technical Meeting on Digital Technologies to Advance Decommissioning of Nuclear Facilities	04-08 September 2023	Vienna International Centre, Austria	1

3. Collaboration work/MOU(ADP/FNCA/MEXT/FTC/IAEA/RCA/TC/S&T/CRP/ In-house project, Universities, etc.)

3.1 Continuous Air Monitoring Station (CAMS)-From 29-11-2018 to be continued

A MoU was signed on 29 November 2018 between Bangladesh Atomic Energy Commission (BAEC) and Department of Environment (DoE) for establishment of Continuous Air Monitoring Station (CAMS) at the roof of TAFD, INST, AERE.

The station has been successfully installed and still operational and gathering valuable air quality data for scientific research. BAEC is providing necessary support and one of TAFD scientist is attached with the said research work.

3.2 IAEA-TC PROJECT TITLE: Strengthening Capacity in the Maintenance and Utilization of the Tandem Accelerator Facility

Code: BGD 0010

Period: From 01-01-2018 to be continued.

The project has been initiated to improve the knowledge in the field of accelerator technology at the institute/facility and to improve the Quality of life in the country.

With the expected Outputs/Outcomes:

- Skilled manpower in the utilization of accelerator based nuclear analytical techniques and innovative research in bio-environmental sciences
- Safe and reliable operation and maintenance of the Tandem accelerator system
- New crop varieties to be developed

Unfortunately, out of fourteen scientific visits and fellowships, only seven are managed to be completed due to COVID situation. So it was one of the reasons for not fulfilling the project outputs.

Still, knowledge and experience gained by the fellowship, scientific visit and expert mission under the project is a valuable achievement. Some important nuclear equipment procured through the project, which are otherwise difficult to obtain. More equipment are still in the process to arrive, thus the project is not closed yet.

4. Repair & Maintenance, Renovation works, etc.

Operation, Repair and Maintenance of 3 MV Tandem Accelerator Facilities Regular operation, various troubleshooting, repair and maintenance works have been done at 3 MV Tandem Accelerator facilities during the reporting period. Here, major tasks among them are described. High vacuum systems of the 3 MV Tandem Accelerator is regularly operated by our operational staffs. 40 KVA main UPS, 2 KVA control cabinet UPS and 15 KVA circulating water cooling system UPS are properly maintained with regular operation and checking. 358 Source is in operational condition by overcoming regulation error problems related to magnet program and magnet monitor on 358 source power supply. LV gauge reading problem is solved by replacing C19, C20, D1 and D2 on X7 slot. Ferrite cores of the driver unit are cleaned and tight position of the screws is adjusted to reduce noise sound during the adjustments. Adjust procedures of radiofrequency driver unit is completed and terminal voltage is generated properly by the unit. Checking the status of the central air cooling unit and the repairing works such as motor of the fan winding, magnetic contactor replacement, gas filling into the compressor, etc., are going on. MPI turbo pump is replaced by IBA1 turbo pump and associated adjustment procedures are completed. After initial repairing of MPI turbo pump, it is installed in IBA1 position. It was running well with different sound but malfunction again. Malfunctioning of turbo roughing valve in MPI location is identified and fixed. Repairing of MPI turbo pump is going on. It is tried to repair old LE turbo pump. SW and MPI cooling water sensor problems are solved by adjusting potentiometer and electric connections. Backup problem of 15 KV circulating water UPS is identified and solved by replacement of all batteries. CANNODE 3 missing problem is identified and solved. Power supply of control room industrial computer is burnt and replaced by new one. The short circuit problem in telemeter box is found and fixed. Fuses of two telemeter can fibre boxes are replaced. The malfunction in adapter of SWITCH box is identified and replaced by new one. After repairing, all instruments, boxes and industrial computer in the control cabinet are working properly. Troubles are identified and tried to fix following the manufacturer's supplied manual sheets and procedures. Every task is written in a Specific log sheets. This will be important and valuable documents for new stuffs of the division. The registered information will be applied to solve the problems which can be faced in near future.

Isotope Hydrology Division, INST

Objective

- Use of isotope techniques to understand groundwater sources, recharge mechanisms, age, flow dynamics, and relationship between different aquifer systems for sustainable water resources exploration, development, and management to supply safe drinking water for the peoples.
- Application of isotope techniques for the assessment of aquifer systems in major urban areas of Bangladesh.
- Developing isotope fingerprints for climate change studies through water isotope monitoring in precipitation collecting from different regions of Bangladesh.
- Exploration and mapping of salinity-free aquifers in coastal regions of Bangladesh using isotope techniques.
- Using isotope techniques tracing the pollutants origin, movement and water quality.
- Evaluation of the artificial recharge in water-scarce regions using isotope techniques.
- Using fallout radionuclides (FRN) techniques to assess soil erosion and sedimentation in the hilly regions of Bangladesh for proper agricultural land management.
- Radiological risk assessment of fallout radionuclides (FRN) in water and soil.
- Application of Cosmic Ray Neutron Sensor (CRNS) technique for efficient use of water for irrigation water management.

1. R&D work(s)

1.1 Enhancing Regional Capability for the Effective Management of Ground Water Resources Using Isotopic Techniques

Ratan Kumar Majumder, Md. Moniruzzaman, Md. Abdul Quaiyum Bhuiyan and Md Ariful Ahsan

The project focus on evaluating environmental isotopes and hydrochemical approaches for identifying groundwater source, recharge mechanism, hydrogeochemical process, natural and anthropogenic drivers of pollutants and seawater intrusion in the southcentral part of Bangladesh. A total of 56 water samples were collected from rivers (n=4), shallow (> 90m depth, n=34) and deep (90-350m, n=18) aquifers for isotope and chemical analysis. Geologically, this area is placed at the lower part of the GBM (Ganges Brahmaputra-Meghna) delta. Moribund, Active, and Matured deltaic sequences are covered in these areas that were deposited during the Plio-Pleistocene and Holocene sedimentary times. The area, part of the GBM delta, features Ca-HCO₃, Na-HCO₃, and Ca-Cl types of water in both shallow and deep aquifers. Shallow groundwater is notably enriched in high levels of NO₂ and NO₃ due to agricultural contamination, while deeper groundwater exhibits higher chloride concentrations as a result of regional groundwater flow and paleo-saline water that was entrapped during the deltaic development. Isotopic analysis reveals that the $\delta^2\text{H}$ and $\delta^{18}\text{O}$ values of shallow aquifer samples are plotted below the Groundwater Mixing Line (GWML) and Local Meteoric Water Line (LMWL), whereas deep aquifer samples align with these lines. The average oxygen isotopic values for the deep aquifer are approximately -6 ‰, accompanied by low tritium levels (<0.4 TU) and low carbon-14 values (<50 pMC), indicating relatively high salinity and an age range of 6,000 to 7,000 years. In contrast, the shallow aquifer shows higher tritium and carbon-14 values (>80 pMC), reflecting recent groundwater recharge from rainfall. Principal Component Analysis (PCA) confirmed the presence of two distinct aquifer systems. These findings imply that the shallow aquifer is unsafe for drinking, while the deep groundwater should be used cautiously to ensure its availability for future generations.

1.2 Improving Water Resources Management Practices by Enhancing the Regional Collaboration in Environmental Isotope Analysis and Applications

Ratan Kumar Majumder, Md. Moniruzzaman, Md. Abdul Quaiyum Bhuiyan and Md Ariful Ahsan

In Bangladesh, 19 coastal districts accommodating more than 32 million people severely impacted by salinity. Salinity ingression may move further inland, affecting more freshwater re-sources in the near future. In some areas, deep groundwater may be the possible source of drinking water supply for city dwellers. However, the excessive use of deep groundwater for drinking water supply may enhance salinity intrusion into the deep groundwater. The prime objectives of the project are to (i) identify the origin of groundwater salinity in the south-western coastal region of Bangladesh using isotope techniques, (ii) mapping the regional geographic distribution of salinity-prone coastal aquifers for the future sustainable groundwater management and (iii) to inform the focal organizations and Government of Bangladesh for the sustainable management and proper use of salinity-free water for future generations. Shallow and deep groundwater samples were collected from Satkhira and Khulna districts. The groundwater in the study area exhibits higher salinity levels, exceeding 0.05%, with collected samples ranging from brackish to brine water. The spatial distribution of salinity, chloride concentrations, and electrical conductivity (EC) values reveals low measurements in the northern part of the area, with a regional increasing trend towards the south. Stable oxygen and hydrogen isotopic data suggest that the groundwater has been recharged primarily from rainfall and floodwater. Additionally, the high chloride concentrations in relation to boron and strontium concentrations in the groundwater samples indicate the presence of seawater within the coastal aquifers. This progressive increase in chloride and $\delta^{18}\text{O}$ values serves as a clear indication of seawater intrusion affecting the coastal aquifers in the study area.

1.3 Evaluating the Efficacy of Artificial Recharge to Groundwater in Water Scarce Regions using Isotope Techniques

Ratan Kumar Majumder, Md. Moniruzzaman and Md. Abdul Quaiyum Bhuiyan

The new RCA project intends to build awareness about the isotope techniques towards evaluating the interventions for augmenting groundwater recharge through artificial recharge measures. The outcome of this project would help effective adaptation of the nuclear related technologies to enhancement of groundwater

recharge through artificial recharge measures and to develop capabilities of sustainable development and management of water resources with special attention to water scarce regions

1.4 Convective Rain Events in the Surma-Kushiyara River Catchment of Bangladesh and Tracing Their Impact on the Catchment with Isotopes

The project aimed to better understand the impact of convective rain events on the hydrological systems in the Surma-Kushiyara (SK) river catchment area, which was crucial for the country's agricultural development. The study used isotope methods, along with conventional hydrological, hydrochemical, and remote sensing data, to understand the nature and degree of interconnection of wetland and groundwater ecosystems, flow regimes, recharge mechanisms of groundwater, hydrochemical processes in the aquifer system, and groundwater flow dynamics within different aquifers. The findings were expected to help in the sustainable development of water resources in the area

2. Manpower Development (Training /Fellowship/ Workshop/Meeting)

2.1 Attend Intraining/Fellowship/Workshop/Meeting

Sl. No	Title of the program	Date	Place	Number of participants
01	First Research Coordination Meeting on Understanding the Importance of convective Rain Events and Tracing.....	April 23-28, 2023	Austria	Dr. Ratan Kumar Majumder
02	Regional Training Course on Mixing Models of Tracers and Complementary Approaches to Apportion Sources of Contaminants in Ground Water	August 28-September 01, 2023	Jakarta, Indonesia	Md. Abdul Quaiyum Bhuiyan
03	MEXT The Nuclear Researchers Exchange Program FY2023	02 Oct 2023-26 Jan 2024	Japan	Md. Abdul Quaiyum Bhuiyan
04	Final Project Review Meeting	October 23 to 27, 2023	China	Dr. Md. Moniruzzaman
05	Workshop on Current Studies on Improving Water Resources Management Using Environment Isotopes Tracers	November 20-23, 2023	Vietnam	1. Dr. Ratan Kumar Majumder 2. Dr. Md. Moniruzzaman
06	International Symposium on Third Pole Environment (ISTPE) 2023	November 13-17, 2023	China	Dr. Ratan Kumar Majumder

3. Organize Training/Fellowship/Workshop/Meeting

Sl. No	Title of the program	Date	Place	Number of participants
01.	Enhancing Regional Capability for the Effective Management of Groundwater Resources Using Isotopic Techniques	30 April, 2024	BAEC Head Quarters	40

4. Oral /Poster Presentation in Seminar/Symposium/Conference(National and International)

Name of the Participant	Title of oral/poster presentation	Title of the event	Organizer	Date	Place
Md. Abdul Quaiyum Bhuiyan	Studies of dose distribution to lung and	Regional Training Course on Mixing	IAEA	August 28-September	Jakarta, Indonesia

	stomach and estimation dose in radiotherapy with ^{60}Co teletherapy beam	Models of Tracers and Complementary Approaches to Apportion Sources of Contaminants in Ground Water		01, 2023	
Dr. Ratan Kumar Majumder	Stable Isotopic Variations in Modern Precipitation of the Tropical Region of Bangladesh	International Symposium on Third Pole Environment	China Academy of Science and Institute of Tibetan Plateau Research	14-17 November 2023	Chongqing, China
Dr. Ratan Kumar Majumder and Dr. Md Moniruzzaman	Environmental Isotope Analysis and Hydrochemical Studies of Groundwater Aquifer in Southwestern Part of Bangladesh: Implications for Improving Water Resources Management Practices	Current Studies on Improving Water Resources Management Using Environment Isotopes Tracers	Institute for Nuclear Science and Technology (INST),	20-23 November 2023	Hanoi, Viet Nam

5. Stakeholder Meeting

Sl. No	Title of the program	Date	Place	Number of participants
01	Enhancing Regional Capability for the Effective Management of Groundwater Resources Using Isotopic Techniques	30 April, 2024	BAEC Headquarters	25

6. Repair & Maintenance, Renovation works, etc.

Title: Restoration of Ion Chromatography instrument functionality

Description: The Ion Chromatography system had been installed and commissioned in 2009 at Isotope Hydrology Division under ADP project. Since after installation, numerous samples have been analyzed through this instrument. Last year, during sample analysis, the pump drive unit of this instrument malfunctioned due to the aging effect of its components. With the assistance of AERE procurement unit, the spare parts of this instrument have been procured from the local supplier. At present, the instrument is functioning, and the sample analysis is going on.

Reactor and Neutron Physics Division, INST

Objective

Reactor and Neutron Physics Division (RNPd) is entrusted with the responsibility of utilization of the research reactor in the country for research and applications in nuclear techniques. RNPd has three major facilities namely, (i) Neutron Scattering, (ii) Neutron Activation Analysis and (iii) Neutron Radiography. All these facilities utilize neutrons generated in the TRIGA Mark II Research Reactor for specific research and discharging services in the nuclear techniques. These research groups mainly focus on characterization of essential materials, analysis of toxic and heavy elements in different sample matrices and studies of structural and building materials for defects and flaws.

1. R&D work(s)

1.1 Neutron Activation Analysis

1.1.1 Elemental Contents of Medicinal Plants of the Sundarban by INAA and AAS Techniques: Health Risk and Elemental Transfer Factor

M. A. Islam, K. Naher, R. Khan, U. Tamim, I. Khalil, M. S. Islam, Aman Ullah, Md. Shahab Uddin

This study evaluates essential and toxic element contents in three widely used medicinal plants (*Acanthus ilicifolius*, *Avicennia officinalis*, and *Xylocarpus mekongensis*) of the Sundarban mangrove ecosystem and the possible health risks through the consumption of these plants. Total concentrations of 20 chemical elements (Al, As, Br, Ca, Cd, Ce, Co, Cr, Fe, K, La, Mn, Na, Pb, Sb, Sc, Sm, Th, V, and Zn) were determined by instrumental neutron activation analysis (INAA) and atomic absorption spectrometry (AAS) techniques. The determined concentrations of the elements were compared with available WHO permissible limits which indicate that the average concentration of Zn in *A. ilicifolius* (41.2 ± 10.1 mg/kg) was higher than that of the permissible WHO limit (27 mg/kg). The average concentrations of Cr in *A. ilicifolius* (3.35 ± 0.37 mg/kg) and *X. mekongensis* (4.02 ± 2.30 mg/kg) were also higher than that of the WHO permissible limit (2 mg/kg). The elemental transfer factors for the medicinal plants were also determined. Therefore, this study will give valuable information to the public about the elemental contents and health risks due to consumption of the medicinal plants.

1.1.2 Radiation Exposure and Health Concerns Associated with the Environmental Geochemistry of Relatively Higher Radioactivity in a Fresh Water Basin

Rahat Khan, M. A. Islam, K. Naher, U. Tamim, M. A. Azam, I. Khalil, M. S. Islam, Aman Ullah and M. S. Uddin

This study was carried out on a negligible anthropogenically impacted Indo-Bangla transboundary river basin (Atrai, Bangladesh) to elicit radionuclides' and elemental distributions. Thirty sediment samples were collected from the Bangladesh portion of the river, and instrumental neutron activation analysis and HPGe γ -Spectrometry techniques were used to determine environmental radionuclides (e.g., ^{232}Th , ^{226}Ra , ^{40}K) and associated elemental concentrations, respectively. Metal concentrations (Sc, V, Fe, Eu, Sm, La, Yb, Ce, Lu, Ta, Hf) were determined to comprehend the genesis of greater radioactivity. Recognizing the mean concentration of absorbed gamma dose rate (158.7 hGy h^{-1}) is 2.88-times more than the recommended value (55 hGy h^{-1}) that describes ionizing radiation concerns regarding potential health risks to the surrounding communities and the houses of native residents, which are constructed by Atrai river sediment. This work will assist relevant policymakers in exploring valuable heavy minerals and provide information regarding radiological health risks from a fluvial system.

1.1.3 Source Specific Sedimentary Response Towards the Differential Anthropogenic Impacts in Terms of Potentially Toxic Elements in an Urban River

Rahat Khan, M. A. Islam, K. Naher, U. Tamim, M. A. Azam, I. Khalil, M. S. Islam, Aman Ullah and M. S. Uddin

To investigate the interplay between varying anthropogenic activities and sediment dynamics in an urban river (Turag, Bangladesh), this study involved 37-sediment samples from 11 different sections of the river. Neutron activation analysis and atomic absorption spectrometry were utilized to quantify the concentrations of 14 metal(oid)s (Al, Ti, Co, Fe, As, Cd, Cr, Cu, Fe, Hg, Mn, Ni, Pb, Zn). This study revealed significant toxic metal trends, with Principal coordinate analysis explaining 62.91% of the variance from upstream to downstream. The largest RSDs for Zn(287%), Mn(120%), and Cd(323%) implies an irregular regional distribution throughout the river. The UNMIX-model and PMF-model were utilized to identify potential sources of metal(oid)s in sediments. ~63.65–66.7% of metal(oid)s in sediments originated from anthropogenic sources, while remaining attributed to natural sources in both models. Strikingly, all measured metal(oid)s' concentrations surpassed the threshold effect level, with Zn and Ni exceeding probable effect levels when compared to SQGs.

3.1.4 Elevated LEVELs of Environmental Radioactivity in Fluvial Sediment: Origin and Health Risks Assessment

Rahat Khan, M. A. Islam, K. Naher, U. Tamim, M. A. Azam, I. Khalil, M. S. Islam, Aman Ullah and M. S. Uddin

To study the geogenic processes of naturally occurring radioactive materials' distribution, a transboundary Himalayan River (Punarbhaba) is chosen due to its trivial anthropogenic impacts. In explaining the genesis of radionuclides, transition elements (Sc, Ti, V, Fe), rare-earth-elements (REEs: La, Eu, Ce, Yb, Sm, Lu), Ta, Hf, Th, and U were analysed in 30 riverbed sediments collected from Bangladeshi portion of the river. Elemental abundances and NORMs' activity were measured by neutron activation analysis and HPGe-Gamma-Spectrometry, respectively. Average_{n=30} radioactivity concentrations of ^{226}Ra (68.4 Bq.kg^{-1}), ^{232}Th (85.7 Bq.kg^{-1}), and ^{40}K (918 Bq.kg^{-1}) were 2.0-2.3-folds, which shows elevated results than those of corresponding world mean values. Additionally, mean-REE abundances were 1.02-1.38-times higher than crustal origin. Elevated (relative to earth-crust) ratios of $\text{Th/U}(=3.95\pm1.84)$, $^{232}\text{Th}/^{40}\text{K}$ and statistical demonstrations invoke Th-dominating heavy minerals, indicating the role of kaolinite clay mineral abundance/granitic presence. However, Th/Yb , La/V , Hf/Sc , and Th/Sc ratios reveal the presence of mafic abundances, hydrodynamic sorting, and recycling of sedimentary minerals. Geo-environmental indices demonstrated the enrichment of chemical elements in heavy minerals, whereas radiological indices presented ionizing radiation concerns, e.g., average absorbed-gamma-dose rate (123.1 nGy.h^{-1}) is 2.24-fold higher compared to the threshold value which may cause chronic health impacts depending on the degree of exposure. Mean excess lifetime cancer risk value for carcinogen exposure is $5.29\times10^{-4} \text{ Sv}^{-1}$, which is ~2-times greater than the suggested threshold. Therefore, plausible extraction of heavy minerals and using residuals as building materials can alleviate the two-reconciling problems: (1) radiological risk management and (2) fluvial navigability.

1.2 Neutron Radiography

1.2.1. Investigation of Lab-made Thermal Neutron Shielding Composites to be Used in the Collimator at the Tangential Beam Port of BTRR

Sudipta Saha, Md. Saiful Islam

The thermal neutron shielding materials were prepared in the laboratory and irradiated by the direct film neutron radiography technique to thermal neutrons from the BTRR. The obtained images were characterized using the optical density values at different positions. Our present report should contribute to nuclear science community researchers for a comprehensive theoretical and corresponding qualitative experimental analysis.

1.3 Neutron Scattering

1.3.1 Influence of Cr Substitution on Structural Properties of Mg-Ni-La Nano Ferrites

M. S. Islam, M. S. Aktar, S. Hossain, J. Maudood, A. Hye and F. Ahmed

Chromium-doped magnesium-nickel-lanthanum nano ferrites $\text{Mg}_{0.5}\text{Ni}_{0.5}\text{La}_{0.05}\text{Cr}_x\text{Fe}_{1.95-x}\text{O}_4$ with composition $x = 0, 0.05, 0.1, \text{ and } 0.15$ have been synthesized by sol-gel auto-combustion method and all samples were annealed at 600°C for 8 hours. The structural properties of the products were characterized by X-ray Diffraction (XRD). XRD experiment showed sharp peaks indicating all samples are cubic spinel structures having single phases with space group $\text{Fd-}3\text{m}$. The lattice parameters of the samples were determined from XRD. The crystallite size, volume, bulk density, X-ray density, and porosity were measured from XRD data analysis. The increase in chromium concentration caused a decrease in the average crystallite size and lattice constant. The crystallite size has been determined in the range $16.332\text{-}12.376\text{nm}$. So, the substitution of chromium in $\text{Mg}_{0.5}\text{Ni}_{0.5}\text{La}_{0.05}\text{Cr}_x\text{Fe}_{1.95-x}\text{O}_4$ nano ferrites enhances the structural properties of the nano ferrites.

1.3.2 Study the Properties of Zinc Doped Strontium Manganate as Perovskite

M. S. Islam, M. S. Aktar, S. Hossain, J. Maudood, A. Hye and F. Ahmed

The zinc doped strontium manganate (SrMnO_3) with the general formula $\text{SrMn}_{1-x}\text{Zn}_x\text{O}_3$ ($x = 0.1, 0.2, 0.3$ and 0.4) were synthesized by the sol-gel method. The structural, optical and dielectric properties of the synthesized samples were investigated by X-ray diffraction (XRD), Fourier Transform Infrared Spectroscopy (FTIR), UV-Vis Spectroscopy and Impedance Spectroscopy. The XRD results confirmed that the prepared samples are single phase materials with an orthorhombic symmetry and Pmmm space group. It was found that

the crystallite size increases with increasing Zn doping. The FTIR analysis further confirmed the structural results collected via the XRD analysis. The optical band gap energy ~1.98 eV, 1.88 eV, 2.09 eV and 2.08 eV for $x = 0.1, 0.2, 0.3$ and 0.4 ; respectively were estimated from the Tauc plot by using UV-Vis absorption data which decrease initially with Zn doping and increase for increase in Zn^{2+} concentration further. The frequency dependent dielectric properties were investigated. The dielectric constant and dielectric loss of all the samples decrease with increase in frequency as well as the value of Zn decreases with increases in concentration.

2. Attended in Seminar/Symposium/Conference/Workshop/Meeting

Sl.No	Name of the participant (s)	Title of the event	Organizer	Date	Place
a)	Dr. Kamrun Naher	FY 2023 FNCA hybrid workshop on Research reactor utilization project	MEXT and NSRA, Japan	17-19 October, 2023	Bangkok, Thailand
b)	Dr. Mohammad Amirul Islam	5th International Conference on Physics for Sustainable Development and Technology (ICPSDT)-2023	CUET	7-8 September 2023	CUET
c)	Dr. Mohammad Amirul Islam, Dr. Shahzad Hossain	International Conference on Physics 2024	Bangladesh Physical Society	9-11 May, 2024	Atomic Energy Center, Dhaka
d)	Dr. Mst. Sanjida Aktar	Training Course on PPR-2008 and Public Procurement Management-2024	BAEC	28 January-08 February, 2024	TI, Savar, Dhaka
e)	Dr. Sudipta Saha	Training Course on PPR-2008 and Public Procurement Management-2024	BAEC	28 January-08 February, 2024	TI, Savar, Dhaka
f)	Jobair Maudood	Instructor Training Course 2023 on Reactor Engineering	IAEA	05 July – 08 August, 2023	Nuclear Human Resource Development Center, IAEA, Japan.
g)	Md. Saiful Islam	BCSIR congress-2023	BCSIR	08-10 March, 2024	BCSIR, Dhaka

3. Collaboration work/MoU

RNPD has collaboration with

- i. Sunway University, Malaysia
- ii. Indian Institute of Technology, Kharagpur, India
- iii. Prince of Songkla University, Thailand
- iv. Suez Canal University, Egypt
- v. University of Brunei Darussalam, Brunei Darussalam
- vi. University of St. Andrews, UK
- vii. Kyungpook National University, South Korea
- viii. Nakhon Pathom Rajabhat University, Thailand
- ix. University of Dhaka, Bangladesh
- x. Military Institute of Science and Technology, Bangladesh
- xi. Atomic Energy Centre, Dhaka (AECD)

NAA group of RNPD actively participate in “Research Reactor Utilization/NAA” FNCA project.

INSTITUTE OF ELECTRONICS (IE), AERE**General Electronics Division, IE****Objective**

This division deals with the design, development, and fabrication of electronic and nuclear instruments which are mainly used for testing and measuring purposes. Several Nuclear Instruments have been designed in the General Electronics Division. These are Portable Radiation Dose Rate Meter (MDGE), Hand and Foot Radiation Monitor (HFRM), and Scintillation Survey Meter (SSM). These Instruments have been supplied to different Institutes and Industries across the country.

1. Research and Development Activities**1.2 Microcontroller Based Portable Radiation Dose Rate Meter (DRMIE)**

Microcontroller-based Radiation Dose Rate Meter (DRMIE) has been designed and developed with LCD display and working satisfactorily. The improvement work of this meter is going on.

1.3 Design and Development of a Microcontroller-Based Area Radiation Monitoring System (ARM)

Area Radiation Monitors are used in nuclear installations to ensure the radiation safety of the personnel. Design and Development of microcontroller-based digital ARM has been completed in cooperation with the Nuclear Electronics Division. After fabrication one ARM has been supplied to BINA, Mymensingh and GSD, IFRB, AERE. A new design has been developed and it's Working Satisfactorily.

1.4 Precision Healthcare: A Deep Dive into Machine Learning Algorithms and Feature Selection Strategies for Accurate Heart Disease Prediction

A comprehensive exploration of machine learning algorithms (MLAs) and feature selection techniques for accurate heart disease prediction (HDP) in modern healthcare. By focusing on diverse datasets encompassing various challenges, the research sheds light on optimal strategies for early detection. MLAs such as Decision Trees (DT), Random Forests (RF), Support Vector Machines (SVM), Gaussian Naive Bayes (NB), and others were studied, with precision and recall metrics emphasised for robust predictions. Our study addresses challenges in real-world data through data cleaning and one-hot encoding, enhancing the integrity of our predictive models. Feature extraction techniques—Recursive Feature Extraction (RFE), Principal Component Analysis (PCA), and univariate feature selection—play a crucial role in identifying relevant features and reducing data dimensionality. Our findings showcase the impact of these techniques on improving prediction accuracy. Optimized models for each dataset have been achieved through grid search hyperparameter tuning, with configurations meticulously outlined. Notably, a remarkable 99.12 % accuracy was achieved on the first Kaggle dataset, showcasing the potential for accurate HDP.

1.5 A Review of Machine Learning And Deep Learning Algorithms for Parkinson's Disease Detection Using Handwriting and Voice Datasets

In recent years, Machine Learning (ML) and Deep Learning (DL) techniques have emerged as promising tools for improving PD diagnosis. This review paper presents a detailed analysis of the current state of ML and DL-based PD diagnosis, focusing on voice, handwriting, and wave spiral datasets. The study also evaluates the effectiveness of various ML and DL algorithms, including classifiers, on these datasets and highlights their potential in enhancing diagnostic accuracy and aiding clinical decision-making. Additionally, the paper explores the identification of biomarkers using these techniques, offering insights into improving the diagnostic process. The discussion encompasses different data formats and commonly employed ML and DL methods in PD diagnosis, providing a comprehensive overview of the field. This review serves as a roadmap for future research, guiding the development of ML and DL-based tools for PD detection. It is expected to benefit both the scientific community and medical practitioners by advancing our understanding of PD diagnosis and ultimately improving patient outcomes.

1.6 Marine Renewable Energy Harnessing for Sustainable Development in Bangladesh: A Technological Review

The potential of MRE technologies, such as tidal energy, wave energy, wind energy, and ocean thermal energy conversion (OTEC), to deliver clean, dependable, and affordable energy while generating new business opportunities for coastal towns has been examined in this article. The paper emphasizes the importance of employing sustainable and ethical development methods to guarantee that MRE development adheres to the objectives of the Blue Economy. Overall, this review paper offers a road map for Bangladesh's MRE sector's sustainable and inclusive growth, addressing several Sustainable Development Goals (SDGs) in Bangladesh, ranging from clean energy access to climate action, economic growth, and environmental sustainability.

2. Software Development

2.1 Development of Microcontroller-Based Instruments: The software development of Microcontroller Based Instruments is going on.

3. Other Activities

3.1 Production Works

The following Instruments were produced by this time:

Portable Dose Rate Meter, Model: DRMIE-11, Serial No: 012401, User: Institute of Electronics, AERE, Savar, Dhaka

4. Repair and Maintenance work

The following instruments were repaired by this time:

Portable Radiation Dose Rate Meter, Model: DRGE-31, Serial No.: 070401, User: Gamma Source Division, IFRB, AERE, Savar, Date: 30.04.2024.

5. Participation in Colloquia, Seminars, Conference, etc.

2023,5th International Conference on Sustainable Technologies for Industry 5.0 (STI), December 2023 at Dhaka, Bangladesh.

6. Lecture Delivered

The scientist and Engineer of this division delivered lectures on two months long (03.09.2023 to 28.11.2023) Industrial Attachment Training program-2023, held at Institute of Electronics, AERE, Savar, Dhaka. Participant:Sylhet & Magura Polytechnic Institute.

7. Seminar arranged

Seminar arranged by Farhana Hafiz, CE

- i. Topic: Presentation for introducing Acoustic Metamaterials and Conducted Research Works and Its Scope for Practical Applicability,15 June 2023 Speaker: Dr. Md. Anzan-Uz-Zaman, PSO, RICD, IE
- ii. Topic: Experimental Study of Quenching Effect for the Fabrication of High Efficiency Solar Cell, 25 June 2023, Dr. Speaker: Md. AbdurRafiqAkand, PSO, SCFRD, IE
- iii. Topic: Quantum material research for spin electronics and quantum computing using neutron scattering, December 12, 2023, SpeakerMd. Firoz Pervez, SSO, VLSITD

8. Manpower Development/Training Program

- i. Md. Ziaul Hasan Majumder S.O. participated in a training course on “PPR-2008 and Public Procurement Management-2024”, from 28 January to 08 February 2024, organized by the Training Institute at AERE, Bangladesh Atomic Energy Commission, Savar, Dhaka.
- ii. Md. Ziaul Hasan Majumder S.O. participated in a training course on “ Radiation Protection for Radiation Eorkers & RCOs of BAEC, Medical Facilities & Industries-2024”, from 02 to 06 June 2024, organized by the Training Institute at AERE, Bangladesh Atomic Energy Commission, Savar, Dhaka.

9. R&D Project

Md. Ziaul Hasan Majumder S.O. Successfully completedan R&D project for the Ministry of Science and Technology.

Title of the Project: Machine Learning Approach for High-Resolution Antibiotic Drug-Resistant Profiling.

Nuclear Electronics Division, IE

Objectives

- Design, development and fabrication of nuclear instruments for laboratory use.
- Refurbishment of nuclear instruments.
- Repair, maintenance and installation of nuclear and non-nuclear equipment.
- Academic program: Supervise/Guide thesis work.
- Human resource development and training program.

1. Research and Development (R&D) Activities

1.1 Design, Development and Fabrication of the Area Radiation Monitor (ARM)

Area Radiation Monitors are used in nuclear installations to ensure radiation safety of the personnel. Design and Development of microcontroller based digital ARM has been completed in cooperation with General Electronics Division. Development work for inclusion of more channels is going on.

1.2 Design, Development of a Gamma Source Control Console (GSC)

Gamma Source control Console (GSC) is a customized controller for 90kCi Co-60 Gamma irradiator for its research and industrial application. The failure of BRI (Board of Radiation and Isotope Technology) India supplied control console, it stopped Research and Industrial application related to the Irradiator. An emergency system has been setup to continue the Research and industrial application. The Gamma Source Control Console (GSC) developed by the Nuclear Electronics Division of the Institute of Electronics has been working continuously since 2017 in the Gamma Source Division of the Institute of Food and Radiation Biology (IFRB) of the Atomic Energy Research Establishment. Development work of Gamma Source Control Console is going on.

1.3 Design and Development of Ultrasonic Humidity Controller

It is a customized instrument for Insect Biotechnology Division (IBD) of IFRB which is control the humidity of laboratory. Ultrasonic Humidity Controller has been designed by this division and supplied to IBD, IFRB. The development work of Humidity Controller is going on.

1.4 Design and Development of Microcontroller Based Multichannel Radiation Detection System

Multichannel radiation detection system is an instrument used in laboratory and field applications to analyze an input with low-level radioactivity. Development of this system is going on.

1.5 Design and Development of Microcontroller Based Switchover Relay

Changeover relay system is an important part of sophisticated system where a system should run only a few hours and switching to another system which serves the same purpose is very crucial. In many industries, Laboratories certain environment like temperature, humidity is desired and to attain such environment cooler or heater or humidifier is required but such system should not run for a long time as it adversely affects its longevity. Scientist and Engineers of this division has completed the design of microcontroller-based changeover system which will automatically switches to another system after a predefined time.

1.6 Design and Development of High Voltage Power Supply System for Radiation Detection and Monitoring System

High voltage power supply (HVPS) is an elementary part in radiation detection and monitoring system and its importance has increased after entering into the era of Nuclear Power. A HVPS has been designed to power up NaI based scintillation detector and the system can be used to drive GM tube or Si based radiation detector after little adjustment that gives it scalability in the field of radiation detection.

1.7 LDR Based Light Sensor Development for Measuring Ambient Light Intensity

Indoor light intensity monitoring is very essential to maintain an optimum light level according to the specific requirements. Human comfort and wellbeing largely depend on the light level in an indoor environment which may vary from person to person and also according to their time of activities. In this project a light

dependent resistor (LDR) based light intensity sensor is developed which provides a low cost and dynamic solution to measure the intensity of light in lux(lx) unit. We are anticipating, this cost-effective lux sensor will be helpful to monitor light intensity more efficiently compared to other lx sensors available in market.

1.8 Design and Development of Artificial Environment and Monitoring system using Microcontroller

Artificial environment is a very important part of research in the field of biology, micro-biology and medical science. It is being used to have a closer look on the instinctive habit and nature of specific animals, plants and insects. In this experiment Arduino Uno based intelligence system with other related sensors has been developed that monitors surrounding environment's temperature, humidity, light intensity and recreates these variables inside an enclosed area with the help of humidifier-dehumidifier, heater-cooler and lighting system. This artificial environment will make the animals and insects to express their instinctive habits and the observation on their habits will help us to achieve realistic results of laboratory experiments.

1.9 Design and Development of an IoT-based Smart System to Monitor, Control, and Record of Laboratory Environment

This work represents a microcontroller-based automated system employed to monitor and control the laboratory environment from the cloud. A standard LDR (Light Dependent Resistor) based light sensor was developed and a DHT (Digital Humidity and Temperature) sensor was used to acquire surrounding humidity, temperature and light intensity data. Those data were displayed on a Liquid Crystal Display (LCD) and can be accessed from the cloud

1.10 Development of PIC-Based Frequency Counter

Frequency is the fundamental property of any signal that conveys important information in signal processing like radiation dose rate measurement. In these work a PIC16f876 based frequency counter is developed that counts the incoming signal frequency and displays it on an LCD. These system measures frequency up-to 56 kHz and consumes 25 MW of power.

1.11 Development of Cloud Monitoring System

Cloud monitoring system is very essential in modern life. A proto type of cloud monitoring system id developed based on ATmega328p microcontroller. The microcontroller is the main controlling unit of this system that employs an esp8266 module to connect with the nearest Wi-Fi and sends humidity and temperature data to Thing Speak platform. Data sent from the system can be monitored or processed from anywhere in the world accessing Thing Speak platform.

1.12 Design and Development of a PIC Based Digital Dosimeter

Gamma events and dose rate calculation are very crucial in our everyday life to secure us from radiation and radioactive elements. In this design, a digital dosimeter is developed for assessing dose rate, which is highly cost-effective. To detect the gamma events a highly sensitive Geiger Muller (GM Tube) is used which is activated by a high voltage source. The measured dose rate is displayed on a liquid crystal display (LCD) and warned through a buzzer attached to the system. The system is calibrated at SSDL in BAEC and confirmed to give a standard deviation of 0.27, a calibration factor of 1.01 for a 2 mCi source at a one-meter distance. Currently the system is being modified to make it more user friendly.

2. Software Development

Development of Microcontroller Based Instruments

The Software Development of Microcontroller Based Instruments is going on.

3. Repair and Maintenance Work

Following instruments were repaired by this time:

- i. One Ultrasonic Humidity Controller, Model No.-UHCIE-II, Serial No.-051801, IBD, IFRB, AERE, Savar, Dhaka has been repaired on 26/01/2023.
- ii. One Ultrasonic Humidity Controller, Model No.-UHCIE-II, Serial No.-032001, IBD, IFRB, AERE, Savar, Dhaka has been repaired on 27/09/2023.

- iii. One Ultrasonic Humidity Controller, Model No.-UHCIE-II, Serial No.-061701, IBD, IFRB, AERE, Savar, Dhaka has been repaired on 24/09/2023.

4. 3D Design and Printing

Two Turbo Molecular Pump rotor puller (12.5mm dia, 40 mm high, cylindrical type) has been Fabricated for Tandem Accelerator Facilities Division AERE, Savar, Dhaka.

5. Lecture Delivered

1.Engineer and Scientist of this division delivered lecture in the Industrial Attachment Training Programme from 03 September to 28 November, 2023 held at Institute of Electronics, AERE, Savar, Dhaka for the students of different Polytechnic Institute of Bangladesh.

6. Sample Test by SEM (Scanning Electron Microscope)

Following samples were tested by this time

Serial No.	Date	Sample	Sample No.	Institute
1.	16/07/2023	Unknown	03	IRPT
2.	20/07/2023	Unknown	09	CEF
3.	20/09/2023	Unknown	05	NITAR, Savar
4.	26/11/2023	Unknown	07	RIPD
5.	28/01/2024	Unknown	03	IRPT
6.	05/03/2024	Unknown	03	IFRB
TOTAL			30	

Repair And Maintenance Division, IE

Objective

The division has been providing services through repair, maintenance and installation of scientific, nuclear, non-nuclear and medical instruments of different institutions of Bangladesh Atomic Energy Commission (BAEC) and outside of this organization. In addition, with design, development, fabrication and refurbishment activities, expert of this division are also taking part in the new instrument installation in BAEC.

Collaborative research with other divisions, institutes and organizations are also performed in this division.

1. Research and Development (R&D) Activities

1.1 Heart Disease Prediction Using Machine Learning Algorithms: Performance Analysis

S. Saha, M.M. Rahman, T.T. Suki, M.M. Alam, M.S. Alam, and M.A.S. Haque, in: 2024 3rdInt. Conf. Adv. Electr. Electron. Eng., IEEE, 2024: pp. 1–6.

Cardiovascular disease (CVD) is one of the major causes of death worldwide. Early detection of this disease can decrease the mortality rate significantly and it can also reduce the costs of medical treatment. Researchers are trying to develop automated systems using data mining techniques that can help in this regard. Although they would be extremely difficult to build, Machine Learning (ML) based methods for heart disease prediction might be very useful in clinical settings. Moreover, the majority of nations lack doctors specialized in cardiovascular treatments, and a high percentage of cases are misdiagnosed. These issues could be resolved by creating an accurate and effective early-stage heart disease prediction system using ML. In this paper, we propose an ML technique to identify cvd patients depending on different features. We collected a heart disease dataset from the Center for Disease Control and Prevention (CDC) then applied different pre-processing steps, and transformed several attributes to make them readable for the ML algorithms. 5 supervised ML algorithms were implemented and the Random Forest algorithm provided the best outcomes in all the performance metrics that we studied, with maximum accuracy of 91% and, ROC-AUC (Area under the ROC Curve) of 0.91. It also surpasses the performance of other algorithms with a maximum True Positive Rate (TPR) of 0.922 and a minimum False Negative Rate (FNR) of 0.078.

1.2 Natural Language Processing and Machine Learning Approaches to Detect Bangla Hate Speech on Social Media

M.S. Islam, S. Saha, M.M. Alam, N. Kumar Datta, M.H. Ali, M. Mahbub Alam, M.D. Hossain, and M. Golam Moazzam, in: 2023 26th Int. Conf. Comput. Inf. Technol., IEEE, 2023: pp. 1–6.

In this modern era, with the popularity of the Unicode system, many people use Bangla text to express their opinions, comments, emotions on Facebook, Twitter, and YouTube, etc. However, this social connectivity always does not create positive impacts. Trolling, cyberbullying, online harassment, sexual and political abuse, and cybercrime often create a huge negative physiological effect on victims. In most cases, women, children, and celebrities are the victims which may often lead them to depression and suicidal activity. Therefore, at the early stage, cyberbullying and hate speech detection can reduce these cyber crimes. A few researches have been carried out in the Bangla language to detect cyberbullying and hate speech due to annotated corpora, lexical and morphological analyzers. This research aims to design and develop an effective model to detect Bangla cyberbullying and hate speech text with the combination of Natural Language Processing (NLP) and Machine Learning Classifier algorithms. In this study, we have collected 6244 Bangla text data from various online social platforms consisting of 6 categories of hate speeches. Then, we labeled the data into two main classes-bullied and neutral that were used to train our classifiers after preprocessing and features extracted by the Bangla NLP tool and TF-IDF (Term Frequency –Inverse Document Frequency). Our comparative study outlines that, with an accuracy rate of 89% and considering parameters Recall, Precision, Specificity, F-Score, and ROC, the Random Forest Classifier achieves the best results compared to others.

1.3 Bengali Cyberbullying Detection in Social Media Using Machine Learning Algorithms

S. Saha, M.S. Islam, M.M. Alam, M.M. Rahman, M.Z. Hasan Majumder, M.S. Alam, and M.K. Hossain, in: 2023 5th Int. Conf. Sustain. Technol. Ind. 5.0, IEEE, 2023: pp. 1–6.

Social media has become more prevalent and it is now fairly easy to communicate with people online. Social network users have many options to cooperate, interact positively, and exchange information. The same system might create a toxic environment that can create an unpleasant environment for online abuse and bullies. Young adults and celebrities are vulnerable to online abuse more often. That's why cyberbullying should be identified and eliminated from social media because it may significantly lead to psychological as well as emotional suffering. By utilizing Natural Language Processing (NLP), Machine Learning (ML), as well as Deep Learning Models based on Transformers like BERT, we can identify patterns in social media texts used by bullies and create an automated method that can detect abusive texts. In this study, we proposed a reliable machine-learning model for social media cyberbullying detection in the Bengali language. We applied text preprocessing, followed by feature extraction using the TF-IDF vectorizer. Then, we applied 4 ML algorithms and 1 transformer-based pretrained BERT model and evaluated their performances by different performance metrics. Our study found that BERT worked best compared to other algorithms and achieved an accuracy of 90% and an AUC (Area under the ROC Curve) of 0.96.

2. Repair & Maintenance, Refurbishment works

Sl. No.	Name & Description of the Instruments	Intender
01	Furnace, Model:HTL10/17, Serial No:210064, Manufacturer: Thermconce, Country of Origin: Germany , Approximate Price of the Instrument: 33,00,000/- (Thirty three Lac Taka Only)	RNPD, INST, AERE
02	Desktop Computer, Model:XL5008AV, Serial No:LBQTKOD8Y0MOKS, Manufacturer: HP, Country of Origin: China , Approximate Price of the Instrument: 60,000/-(Sixty Thousand Taka Only)	GED,IE, AERE
03	Computer Monitor, Model: HPLE2201W, Serial No:CNK11116LJ, Manufacturer: HP, Country of Origin: China , Approximate Price of the Instrument: 15,000/-(Fifteen Thousand Taka Only)	IE, AERE
04	Computer Monitor, Model:D1918HO, Serial No:CN-OGc2RW-BOZ00, Manufacturer: Dell, Country of Origin: China , Approximate Price of the Instrument: 12,000/-(Twelve Thousand Taka Only)	CEF, AERE
05	Computer Monitor, Model:X93W, Serial	TAFD, INST, AERE

	No:X93WDIE0301384,Manufacturer: YUNDAITcorp, Country of Origin: China , Approximate Price of the Instrument: 10,000/-(Ten thousand Taka Only)	
06	HP Laser Printer, Model: HP Laser Jet p1102/CE651A, Serial No VNF8407011, Manufacturer: HP, Country of Origin: Vietnam/USA, Approximate Price of the Instrument: 16,000/-(Sixteen Thousand Taka Only)	CAD, AERE
07	Laser Printer: Serial No: VNF3C60852,Model: HP Laser Jet p1102/CE651A, Manufacturer: HP, Country of Origin: Vietnam/USA , Approximate Price of the Instrument: 16,000/-(Sixteen Thousand Taka Only)	IFRB, AERE
08	HP Laser Printer, Model: HP Laser Jet p1102,Serial No: VNF5C64477, Manufacturer: HP, Country of Origin: Vietnam/, Approximate Price of the Instrument: 16,000/-(Sixteen Thousand Taka Only)	Store, CAD, AERE
09	Samsung Laser Printer , Model No: ML-1866, Serial No:Z5SVB8GC5A008KV, Manufacturer: Samsung, Country of Origin: China, Approximate Price of the Instrument: 15,000/-(Fifteen Thousand Taka Only)	CEF,AERE
10	Room Heater: Serial No: 34021, Model No: TCH7091ER,Manufacturer:Delonghi, Country of Origin: China , Approximate Price of the Instrument: 20,000/-(Twenty Thousand Taka Only)	IFRB,AERE
11	Epson Scanner V39, Model: J371A ,Serial No:VCHY11019, Manufacturer: Epson Perfection, Country of Origin: Indonesia, Approximate Price of the Instrument: 12,000/-(Twelve Thousand Taka Only)	SIU,AERE
12	Electric kettle, Model: 1500W,Serial No: N/A, Country of Origin: India, Approximate Price of the Instrument: 1500/-(One Thousand Five hundred Taka Only)	READ, IFRB

Other than theses, other electronic equipment related to research are repaired, installed and maintained in this division.

3. Attended in Seminar/Symposium/Conference/Workshop/Meeting

Name of the participants	Title of the event	Organizer	Date	Place
SubrataSaha	5th International Conference on Sustainable Technologies for Industry 5.0 (STI)	Green University, Dhaka, Bangladesh	09-10 Dec. 2023	Green University, Dhaka, Bangladesh
SubrataSaha	26th International Conference on Computer and Information Technology (ICCIT),	IEEE Bangladesh Section	13-15 Dec. 2023	Cox's Bazar, Bangladesh
SubrataSaha	3rd International Conference on Advancement in Electrical and Electronic Engineering (ICAEEEE)	DUET	25-27 April 2024,	Gazipur, Bangladesh

Solar Cell Fabrication and Research Division, IE

Objective

A solar cell fabrication and research lab has been established in BAEC under the project of “Utilization of solar energy and related technology development”. In December, 2013 this lab was merged with Institute of Electronics (IE), Atomic Energy research Establishment (AERE) and started its activities through a new division named “Solar Cell Fabrication & Research Division”. The main objective of this division is research fabrication and characterization of highly efficient solar cells with modules and their applications for socioeconomic development of Bangladesh.

Activities

The establishment of the lab has made it possible to fabricate silicon solar cell for the first time in Bangladesh and make an opportunity to research and develop skilled manpower in the field of solar energy (renewable energy). The present activities/programs of this division include:

- Conducting research in the field of photovoltaic solar energy
- Chemicals and LASER based texturization for silicon solar cell fabrication
- Performance evaluations and characterization of solar cells and panels
- Skilled manpower development in the field of renewable energy

1. R & D work

1.1 Analysis of Etching Impact for High-Efficient Solar Cell Fabrication

M. A. R. Akand, M. K. Basher, S. M. A. A. Zumahi, M. S. Alam and M. A. S. Haque

The analysis of etching impact is a crucial aspect of optimizing the performance and overall efficiency of solar cells. Etching, a pivotal step in solar cell fabrication process, involves selectively removing material from semiconductor surfaces to create intricate patterns and structures for efficient light absorption and charge carrier separation within solar cells. Researchers focus on understanding the impact of different etching techniques, including wet and dry etching, on the morphological and compositional aspects of the solar cell. An in-depth analysis of etching parameters such as etch rate, etchant composition, temperature, and duration is essential to enhance light trapping and absorption for specific solar cell designs. In this study boron doped, p-type, mono-crystalline silicon wafers having dimension $127 \times 127 \text{ mm}^2$ and thickness $200 \mu\text{m}$ were wet etched to analysis the surface morphology for high efficient solar cell fabrication. Etching was performed at 80°C temperature with the systematic variation of etching time from 5 to 20 minute and etchant composition (Potassium hydroxide (KOH), Isopropyl alcohol (IPA) and De-ionized water (DI)). The surface morphology and the light absorption performance of treated wafers were analyzed by DEKTAK Profilometer, Scanning Electron Microscope (SEM) and UV Vis Spectroscopy respectively. The optimized etchant composition shows the lowest surface reflectance of 14.2% with the formation of uniform pyramidal wafer surface. This optimized etching recipe guides the fine-tuning of etching protocol, contributing to the development of high-efficient solar cells fabrication as well as advancement of renewable energy technologies.

1.2 Revolutionizing Solar Energy: Nano-Engineered Silicon Surfaces for High-Efficiency Solar Cells using PC1D

S. M. Amir-Al Zumahi, M. K. Basher and M. A. R. Akand

This study delves into the innovative design and optimization of high-efficiency solar cells on low-reflective mono crystalline silicon surfaces using advanced simulation software. By meticulously adjusting the doping concentrations of n-type and p-type materials, we unveil their profound impact on the generation and recombination processes crucial for solar cell efficiency. Our research introduces a game-changing approach—leveraging copper nanoparticles (Cu-NP) to texture the silicon surface, reducing reflection by a remarkable 0.65%. Through rigorous optimization, we have identified the ideal doping concentration of $1 \times 10^{14} \text{ cm}^{-3}$ across n-type regions of varying thicknesses (5, 10, and $15 \mu\text{m}$), resulting in an unprecedented solar cell conversion efficiency of 26.19%. Notably, our optimized design showcases outstanding performance metrics including an open-circuit voltage (Voc) of 0.749 V, short circuit current (Isc) of 3.987 A, and a fill factor of 26.19%. These findings present a compelling pathway towards fabricating next-generation, high-efficiency solar cells poised to revolutionize renewable energy technologies.

1.3 Advancement of Zinc-Oxide Nanorods on Chemically Etched Zinc Substrates for Enhanced Photovoltaic Solar Cell Performance

S. M. Amir-Al Zumahi, M. K. Basher, M. A. R. Akand, M. S. Alam and M. A. S. Haque

Zinc-oxide (ZnO) nanostructures, particularly nanorods, stand at the forefront of global research, offering promising applications in diverse fields, notably in enhancing photovoltaic solar cell (PSC) efficiency. Our study presents a novel approach to grow and characterize ZnO nanorods on both plain and chemically etched zinc plates using a cost-effective and eco-friendly hot water treatment (HWT) technique. By manipulating

process parameters such as temperature and duration, we meticulously examine the morphological and elemental properties, revealing the formation of well-agglomerated ZnO nanorods with precise stoichiometry. Our findings unveil significant variations in nanorod uniformity, density, thickness, and size across different temperature-time combinations, with chemically etched zinc surfaces yielding thicker and more uniform nanorods compared to non-etched counterparts. This innovative method offers a straightforward solution for producing ZnO nanorods with high density and uniformity, paving the way for the development of next-generation PSCs with heightened conversion efficiency.

1.4 Design, Development and Simulation of a Microcontroller Based Nuclear Survey Meter

M. N. Islam, M. S. Alam and M. A. S. Haque

Design, Development and Simulation of a Nuclear Survey Meter using ATMEL Microcontroller has been presented in this paper. The Nuclear Survey Meter consists of a Nuclear Detector GM(ZP1324)/Scintillation NaI (TI), Detector's Front-end Electronics Preamplifier-Amplifier-Shaper-Discriminator, Atmel Microcontroller as the Processor, LCD display(16 ch, 2-line), low voltage power supply (LVPS) and high voltage power supply (HVPS). An assembly language program based on BASCOM AVR IDE has been developed to control the operation of the nuclear survey meter. The system has been designed and verified in Proteus 7.7 simulation platform and BASCOM Hardware Simulation.

1.5 Comprehensive Study of the 4th Industrial Revolution

M. N. Islam, M. S. Alam and M. A. S. Haque

Comprehensive Study of the 4th Industrial Revolution has been presented in this research. The 4th Industrial Revolution refers to Cyber-Physical-Biological System components are connected and communicated through the Internet of Things (IoT) concept. It affects the changes in individual and society, Politics and governments, employee and organizations as a whole how we work, think, learn, educate, entertain ourselves, commutations and behave with each other. The 4IR Industry 4.0 includes emerging technologies such as Internet of Things (IoT), Artificial Intelligence (AI), Robotics, 3D Printing/Additive Manufacturing, Big Data, Autonomous Vehicles, Cloud Computing, Cyber Security, System Integration and Virtual Reality (VR). The evolution of mobiles, homes and embedded systems are represented by the industry 4.0 which evolution helps to create a SMART world for the people because the objects around us have better knowledge of our likes, wants and needs. As it continues to expand, there is a need of flexible, layered architecture to connect billions or trillions of heterogeneous objects via the internet. While projects like SMART system are tasked with designing a common architecture, a dominant choice has yet to be defined. Most initial models featured a three-layer or five-layer architecture consisting of the Perception, Network and Application layers or Perception Layer, Transport Layer, Processing Layer, Application Layer and Business Layer. Various applications of 4IR are not limited to smart home, smart city, smart grid, smart traffic, smart education, smart healthcare, smart agriculture, wearable technology, smart retail, smart supply chain and smart industries have been discussed. Challenges of SMART systems are risks of security, privacy problems and standardization & regulatory frameworks have been presented as well.

1.6 Study of Crystalline Silicon Solar Cell Fabrication Technology

M. N. Islam, M. S. Alam and M. A. S. Haque

Study of Crystalline Silicon Solar Cell Fabrication Technology has been presented in this research. This study includes solar cell configurations such as monofacial, bifacial or back contact solar cells. Solar cell efficiency that increased in early phase due to semiconductor processing, contact resistance 16% to 25% in second phase after eighties for wafer quality, minority carrier lifetime. The study also includes manufacturing cost which refers to silicon wafer thickness that represents 50 % cost of a solar panel. The wafer thickness has been reduced from 400 μ m to 200 μ m and fabrication process diagrams. Industrial solar cell manufacturing of crystalline silicon solar cells whether it is with a toxic SiH₄ and POCl₃ based or Saline and POCl₃ free fabrication process, they all share the common fabrication steps in the process diagram are Wafer inspection, damage removal & texturing and screen printing Ag/Al. Varies in the emitter formation step as POCl₃ diffusion, Phosphoric acid diffusion, Thermal oxidation or In-situ oxidation. Highest Internal quantum efficiency with least integrated surface reflectance in the visible region, Higher reflectance in UV and IR

region due to light escaping in the solar cell and LIV measurements for solar cells have been presented as well.

1.7 Comprehensive Study on Internet of Things (IoT) Components, Architectures, Operating Systems and Applications

M. N. Islam, M. S. Alam and M. A. S. Haque

A comprehensive Study on Internet of Things (IoT) Components, Architectures, Operating Systems and Applications has been presented in this article. In today's IoT systems, all different existing and emerging IoT architecture patterns share one set of common components such as physical device, edge and platform. There are number of architecture patterns have emerged and are gaining widespread acceptance and implementation. The Three Layer Architecture can be broken into Perception Layer, Network Layer and Application Layer. Consequently for the Five Layer Architecture consists of Perception Layer, Transport Layer, Processing Layer, Application Layer and Business Layer. The importance of IoT device operating systems (OSs) has been recognized. An adequate OS with a kernel, networking, real-time capability, multitasking and more can make these devices flexible. Various applications of IoT are not limited to smart home; smart city, smart grid, smart traffic, education, healthcare, smart agriculture, wearable technology, smart retail, smart supply chain and smart industries have been discussed. Challenges of IoT privacy problems, security risks and standardization & regulatory frameworks have been presented as well.

2. Attended in Seminar/Symposium/Conference/Workshop/Meeting

Name of the Participant	Title of the event	Organizer	Date	Place
Engr. Md. Nazrul Islam,	“International Conference on Electronics and Informatics 2022”	BEIS	26 - 28 January, 2023	Dhaka
	60 th IEB Convention, “Innovative Engineering in the 4 th Industrial Revolution”	Institution of Engineers' Bangladesh (IEB)	11 - 16 May, 2023	Dhaka
	61 th IEB Convention, “Engineering and Technology for SMART Bangladesh”	Institution of Engineers' Bangladesh (IEB)	09 - 14 May, 2024	Dhaka
	“National Conference on Physics - 2023”	BPS	09 - 11 March, 2023	Savar
Engr. Md. Nazrul Islam, Dr. M. A. Rafiq Akand & Mr. S. M. Amir-Al-Zumahi	Lecture delivered in the Industrial Attachment Training Programme-2022 for the students (58) of SIMT, Norshingdhi, Kishoreganj, Magura, Hobiganj, Mymensingh and Tangail Polytechnic Institutes	Institute of Electronics (IE)	October 10 - December 29, 2022.	Savar

Robotics Instrumentation and Control Division, IE

Objective

This division is involved in the design and development of various types of control systems that help in the customized use of various types of scientific instruments used in various laboratories of BAEC and other organizations. Besides this division helped to design, simulate, prototyping, interfacing, and real-time control of robotic systems applicable to various laboratories and nuclear installations. Moreover, research using meta-materials, optical materials, and energy materials and devices is also currently performed in this division.

1. R&D work

1.1 Optimization of the Architecture of Lead-Free CsSnCl₃-Perovskite Solar Cells for Enhancement of Efficiency: A Combination of SCAPS-1D and wxAMPS Study

M. K. Hossain et al., *Mater. Chem. Phys.*, vol. 308, p. 128281, Oct. 2023.

Lead-free perovskite of cesium tin chloride (CsSnCl_3) is being considered as a potential environmentally acceptable alternative for highly efficient perovskite solar cells (PSCs) for the outstanding optoelectronic properties and reduced biotoxicity and non-hazardous characteristics. The poisonous nature and poor environmental stability of lead (Pb)-based perovskite are major hurdles to their reliable applications, even though their power conversion efficiency (PCE) has exceeded 25%. In this research, the potential of thermally stable, non-toxic CsSnCl_3 perovskite for designing high-efficiency solar cells was explored using the SCAPS-1D software. The influence of CsSnCl_3 layer thickness, acceptor density, and defect density was studied to obtain optimum values as a reference cell, and the effect of these parameters on six electron transport layers (ETLs) as well as $\text{Cu}_2\text{BaSnS}_4$ (CBTS) hole transport layer (HTL) was also evaluated. The impact of series resistance, shunt resistance, and the working temperature on the electrical parameters of the cell and corresponding quantum efficiency were also assessed. The ITO/ $\text{ZnO}/\text{CsSnCl}_3/\text{CBTS}/\text{Au}$ heterostructure was found to be the most efficient device among six different configurations, with a champion PCE of 23.96%, J_{SC} of $23.5 \text{ mA}/\text{cm}^2$, V_{OC} of 1.04 V, and FF of 86%. These results were validated by results obtained from the wxAMPS and a comparative study with recent reports was also performed. These validated simulation results provide a greater understanding of the eco-friendly CsSnCl_3 -based perovskite and its potential for applications in modern prominent photovoltaic and optoelectronic devices.

1.2 Biomolecule Detection Using $\text{GaAs}_{1-x}\text{Sb}_x$ FET Based Dielectric Modulated Label-Free Biosensor

Dixit, D.P. Samajdar, R.P. Shukla, N. Bagga, M.K. Hossain, *Phys. Scr.*, vol. 99, 025020, Jan 2024.

Dielectric Modulated (DM) biosensors are being developed for label-free biosensing based on varying dielectric constants of the cavity region. In this paper, we proposed a $\text{GaAs}_{1-x}\text{Sb}_x$ based cylindrical DM biosensor. The chosen device geometry provides enhanced gate control and increases cavity area compared to the planar devices. This bestows larger dwelling space to the biomolecules. In our work, we have investigated the sensing capability of the proposed biosensor for Biotin ($k = 2.63$), Bacteriophage ($k = 6.3$), and Gelatin ($k = 12$); whereas, the proposed study is applicable in all types of biomolecules which are characterized by the dielectric constants. The deviation in the effective oxide thickness (EOT) due to the variation in permittivity of the cavity area modulates the channel conductance and, in turn, ON current and threshold voltages (V_{th}). Thus, these parameters can be used for analyzing the sensitivity. For the gelatin biomolecule, the maximum computed sensitivity with regard to the OFF to ON current ratio and saturation current is 41.20% and 16.68%, respectively. Further, we also investigated the sensitivity metrics for the charge-carrying biomolecules using trap models employed in TCAD simulations.

1.3 Synergistic Blends of Sodium Alginate and Pectin Biopolymer Hosts as Conducting Electrolytes for Electrochemical Applications

R. Jansi, B. Vinay, M.S. Revathy, P. Sasikumar, L. Marasamy, A. Janani, R. Haldhar, S.-C. Kim, Z.M. Almarhoon, and M.K. Hossain, *ACS Omega*, vol. 9, p. 13906, March 2024.

The world needs sustainable energy resources with affordable, economic, and accountable sources. Consequently, energy innovation technologies are evolving toward electrochemical applications like batteries, supercapacitors, etc. The current study involves the solid blend biopolymer electrolyte (SBBE) with different compositions of sodium alginate blended with pectin via the casting technique. The characterization of the sample was tested by X-ray diffraction (XRD), Fourier transform infrared (FTIR) spectroscopy, AC impedance, linear sweep voltammetry (LSV), and cyclic voltammetry (CV) analyses. Evidently, the sample NP4 ($\text{NaAlg}/\text{pectin} = 60:40 \text{ wt } \%$) has a higher conductivity of 1.26×10^{-7} and $3.25 \times 10^{-6} \text{ S cm}^{-1}$ at 303 and 353 K, respectively. The performances of the samples were analyzed with variations in temperature, frequency, and time responses to signify the blended nature of the electrolyte. Hence, the studied biopolymers can be constructed for electrochemical device applications.

1.4 Growth, Spectral, Optical, and Third Harmonic Generation Studies of p-Hydroxyacetanilide (PHA) Crystals

K. Bhavani, J. Christina Rhoda, M.K. Hossain, and C. Karnan, *Opt. Mater. (Amst)*, Vol. 148, p. 114924, Feb. 2024.

An organic *p*-Hydroxyacetanilide (PHA) crystal was grown using the slow evaporation technique. The PHA crystal crystallized in the monoclinic crystal system with centrosymmetric space group $P2_1/a$. The functional groups in the crystal were identified using Fourier-transform infrared and Raman spectroscopy analyses. The crystallization quality of the PHA crystal was investigated using the high-resolution X-ray diffraction technique. In addition, the linear optical properties of the crystal were discerned using UV–Vis–NIR spectroscopy. Maximum absorption in the ultraviolet region and low absorbance in the visible region were observed for the crystal. The cut-off wavelength for the crystal was observed at 318 nm, which substantiated its utilization for optoelectronic device applications. The refractive index of the crystal was determined to be 1.53. Further, the crystal was excited at 300 nm and emission spectra were recorded using photoluminescence spectroscopy. Violet fluorescence peak was observed at 330 nm. Laser damage threshold (LDT) analysis was performed to identify the limit of performance of the crystal. The LDT value for the PHA crystal was calculated to be 23.7 GW/cm^2 , which is higher than those of standard nonlinear optical materials. The third-order NLO properties of PHA crystal were investigated using the Z-scan technique. The optical nonlinear susceptibility and nonlinear refractive index values of the crystal were $2.846 \times 10^{-4} \text{ esu}$, and 5.250×10^{-7} , respectively. The results of this study corroborate the applications of the crystal in optoelectronics field.

Very large Scale Integration (VLSI) Technology Division, IE

Objective

The VLSI laboratory was established at Institute of Electronics in Atomic Energy Research Establishment by Bangladesh Atomic Energy Commission in 2012 to conduct advance cutting-edge semiconductor and electronic research. This lab has two clean rooms (a 10,000-grade white room and a 1,000-grade yellow room), along with a number of high-tech synthesis and characterization tools, allowing scientists to develop, produce, and characterise semiconductor materials and devices. The VLSI Laboratory opens a new horizon in microelectronics and semiconductor research for the first time in Bangladesh.

Activities

1. Research and Development Activities

- Research on thin film electronic, optoelectronic materials, and condensed matter for high performance electronic device
- Effect of radiation on semiconductor material used in electronic device
- Compound semiconductor research for microelectronics/optoelectronics devices
- Structural and optical property investigation of Gamma (γ) irradiated MoO_3 nanoparticle and thin films.

2. Seminar/Workshop

- i. Seminar on “Quantum material research for spin electronics and quantum computing using neutron scattering” presented by Mr. Firoz Pervez, SSO, on 11th December 2023
- ii. Participate the seminar “To meet the challenges of the 4th industrial revolution” on 06/06/2024

Production Division, IE

Objective

The Production Division is mainly engaged with fabrication, assembling and repair of the electronic instruments in order to meet the requirement of different institutes of BAEC and other organizations of the country.

1. Production work

1.1 Production of Digital pH Meter: Quantity - 01

Specifications: Measuring range: 0-14 pH, Resolution: 0.01 pH, Input Impedance: 10^{12} Ohms, Accuracy: ± 0.01 pH, Type of pH electrode: Combination type, Temperature compensation: Manual, Input Base current: 10 Pico Amp. (Approx.), Power requirement: 220 V AC, 50Hz, Readout: 3.5 digit display, Weight: 1.5 Kg (Approx.).

1.2 Production of A.C. Voltage Stabilizer: Quantity - 01

Specifications: Upper cut-off voltage: 270V, Lower cut-off voltage: 120V, Time delay: Direct (No delay), 30 sec (For TV/Comp): 3 min (For Fridge), Stabilized output: 205-235V, Input voltage: 220VAC, 50Hz, Type: 160-250V, Weight: 8 Kg (Approx.).

1.3 Production of Drop-Out-Relay: Quantity - 04

Specifications: Upper cut-off voltage: 250V, Lower cut-off voltage: 160V, Time delay: 3 min (Adjustable), Input voltage: 220VAC, 50Hz, Output (safe range): 160-250V, Weight: 1.8 Kg.

2. Organize training/fellowship/workshop/meeting

Sl. No.	Title of the program	Date	Place	Number of participants
a.	Industrial Attachment Training Program - 2023	03-09-2023 to 28-11-2023	IE,AERE	18

3. Service Rendered

Sl. No.	Name of service provided	Number/quantity of sample/ patient/service	Revenue income
a.	Drop-Out Relay	01	1,800/=
b.	pH Electrode	01	15,000/=

4. Repair & Maintenance works

Title: Repair of Digital pH Meter: Quantity - 03

Description: Some components were damaged. Replace the components and other necessary servicing was done.

Title: Repair of Drop-out Relay : Quantity – 05

Description: Some components were damaged. Replace the components and other necessary servicing was done.

Title: Repair of Voltage Stabilizer: Quantity – 01

Description: Some components were damaged. Replace the components and other necessary servicing was done.

INSTITUTE OF COMPUTER SCIENCE (ICS)

The Institute of Computer Science (ICS) was gently established in December 1981 at the Atomic Energy Research Institute in Savar, with the tender purpose of offering research, development, training, and consultancy. The country's first computer, the IBM-1620, was delicately installed in the computer department of the Atomic Energy Center in Dhaka in 1964. This beloved IBM computer became well-known for graciously providing training and data processing services to scientists and researchers of BAEC and other institutes. Later, in 1983, another mainframe computer, the IBM-4341, was lovingly installed at the Institute of Computer Science. For another decade, it sweetly served various government agencies and scientists with training, data processing, and research.

With the gentle promotion and spread of information technology over the last decade, this field has softly touched all areas of science and beyond. As a result, information technology has brought about a profound change in Bangladesh, contributing warmly to the country's socio-economic development. In harmony with this, ICS is tenderly providing science-based research and services, carefully integrating nuclear science, technology, and ICT for the peaceful and serene use of nuclear energy.



IBM-1620



IBM-4341

The Institute of Computer Science provides research, development, training, consultancy and various services through three divisions:

1. Computer Systems and Networking Division (CSND)
2. Software Engineering Division (SED)
3. Nuclear Cyber Security Division (NCSD)

Computer System And Network Division (CSND)

Objective

Computer System and Network Division is mainly responsible for designing, and implementation of computer networks and use of software for using manageable the network. CSND is to provide services of Computer hardware/software installation/ maintenance & troubleshooting and development/up-gradation of the network infrastructure of BAEC, Broadband and Wi-Fi internet service, ID card preparation for BAEC employees/students/visitors Manpower development, IT training and consulting services to BAEC. The division conducts policy and ICT-relevant national and international collaboration work with the Ministry of Science & Technology.

Activities

1. R&D work(s)

1.1 A Machine Learning (ML) Approach to Predict the Prodrome Step of Migraine by Analyzing the Trigger Incidents

Md. Mahbub Alam, Md. Haidar Ali, Md. Shamimul Islam, Nayan Kumar Dutta, Osman Goni, Abu Shameem and Dr. Md. Dulal Hossain

Migraine is one of the most commonly occurring ailments affecting the nervous system. It affects mostly the adult population and shows female predominance. Unilateral throbbing type moderate to severe intensity headache is a common manifestation of the migraine though it may present with varied presentation. Our study aims to predict the prodrome step of migraine by analyzing different trigger incidents using machine learning algorithms.

1.2 Optical Fiber Network Route Planning, Design and Deployment for Atomic Energy Research Establishment

Md. Haidar Ali, Osman Goni, Md. Mahbub Alam, and Abu Shameem

A high-quality and correctly dimensioned network infrastructure is essential for all well-functional IT systems. An optical fiber-based network can ensure high speed as well as a high-quality network. To fulfill the current requirements of AERE (Atomic Energy Research Establishment), considering its smooth operation of high-speed internet service, the optical fiber-based network is the state-of-the-art network solution. An optical fiber network design refers to the specialized processes leading to a successful installation and

operation of a fiber-optic network which includes determining the type of communication system(s) which will carry over the network, the geographic layout, the transmission equipment required, and the fiber network over which it will operate.

1.3 Implementation of Local Area Network (LAN) & Build a Secure LAN System for BAEC Head Quarter

Md. Haidar, Md. Mahbub Alam, Osman Goni and Abu Shameem

Network security is the process of taking physical and software preventative measures to protect the underlying networking infrastructure from unauthorized access, misuse, malfunction, modification, destruction, or improper disclosure, thereby creating a secure platform for computers, users, and programs to perform their permitted critical functions within a secure environment. A local area network (LAN) is a computer network within a small geographical area such as a home, school, computer laboratory, office building or group of buildings. A LAN is composed of inter-connected workstations and personal computers which are each capable of accessing and sharing data and devices, such as printers, scanners and data storage devices, anywhere on the LAN. LANs are characterized by higher communication and data transfer rates

And the lack of any need for leased communication lines. A data network is an interconnected system of computers, peripherals and software over which data files and messages are sent and received. LAN is only one type of computer network. LAN defines a data communication system allowing a number of independent devices to communicate directly with each other, within a moderately sized geographic area over a physical communications channel of moderate data rates. Fiber-optic communication is a method of transmitting information from one place to another by sending pulses of infrared light through an optical fiber. The light is a form of carrier wave that is modulated to carry information. Fiber is preferred over electrical cabling when high bandwidth, long distance, or immunity to electromagnetic interference is required. This type of communication can transmit voice, video, and telemetry through local area networks or across long distances. Optical fiber is used by many telecommunications companies to transmit telephone signals, Internet communication, and cable television signals. Researchers at Bell Labs have reached a record bandwidth distance product of over 100 petabit × kilometers per second using fiber optic communication. Communication between remote parties can be achieved through a process called Networking, involving the connection of computers, media and networking devices. When we talk about networks, we need to keep in mind three concepts, distributed processing, network criteria and network structure. The purpose of this Network is to design a Local Area Network (LAN) for a BAEC (Bangladesh Atomic Energy Commission) Head Quarter and implement security measures to protect network resources and system services. To do so, we will deal with the physical and logical design of a LAN. The goal of this Network is to examine the Local Area Network set up for a BAEC HQ and build a secure LAN system.

1.4 Design and Deployment of Optical Fiber Network at Atomic Energy Centre, Dhaka

Osman Goni and Abu Shameem

Fiber-optic communication is a method of transmitting information from one place to another by sending pulses of infrared light through an optical fiber. The light is a form of carrier wave that is modulated to carry information. Fiber is preferred over electrical cabling when high bandwidth, long distance, or immunity to electromagnetic interference is required. This type of communication can transmit voice, video, and telemetry through local area networks or across long distances. Optical fiber is used by many telecommunications companies to transmit telephone signals, Internet communication, and cable television signals. Researchers at Bell Labs have reached a record bandwidth distance product of over 100 petabit × kilometers per second using fiber optic communication.

To fulfill the current requirements of Atomic Energy Center, Dhaka considering its smooth operation of high speed internet service, optical fiber based network is the state-of-the-art network solution. An optical fiber network design refers to the specialized processes leading to a successful installation and operation of a fiber optic network which includes determining the type of communication system(s) which will be carried over the network, the geographic layout, the transmission equipment required and the fiber network over which it will operate. Atomic Energy Centre, Dhaka (AECDC), considered as the pioneer institution of the Bangladesh

Atomic Energy Commission (BAEC) is now one of its research establishments located at the core of Dhaka city was established in 1961 to carry out research and development activities in the field of nuclear science and technology for peaceful purposes. For that, here internet is essential. So optical fiber network design and deployment at Atomic Energy center is very important.

1.5 Implementation of Local Area Network in Thyroid Disease Management at INMAS, Dhaka

Md. Abu Shameem, Osman Goni, Md. Haidar Ali, Md. Mahbub Alam, Mizanur Rahman

A Computer Network is an arrangement that enables two or more computers to communicate (“talk”) to each other, sharing resources, information and services. This basically implies that it is possible to reach every nook and corner of the state fast, easily, and comfortably. Same analogy can be extended to networks of computers. Network of computers implies linking computers through some kind of a communication links. This does not mean simply connecting the computers through some wires, instead it also includes the software that makes this hardware work, and also ensures that the information between these computers is exchanged without any loss or distortion. In short, it encompasses the whole gamut of hardware and software component that make a computer network operate. A Network of computer help exchange information between computers. LANs come in many sizes. A group of devices connected through a home internet connection is a LAN. Small businesses have LANs that connect a dozen or a hundred computers with printers and file storage. The largest LANs are controlled by a server that stores files, shares data between devices, and directs files to printers and scanners. Institute of Nuclear Medicine and Allied Sciences (INMAS), Dhaka is offering specialized medical services on following areas - Scintigraphy, Ultrasound & CD, PET-CT, Thyroid, Nuclear Cardiology, Nuclear Nephrology, In-Vitro, Therapeutic, etc. The Institute is run under Bangladesh Atomic Energy Commission (BAEC), under the Ministry of Science and Technology, Government of the Peoples Republic of Bangladesh. The slogan of “Digital Bangladesh” of the Government of Bangladesh has special significance for national development. Digital Bangladesh with Vision 2021 is a big impetus for the use of digital technology in the country. Hence, Thyroid Disease Management works of INMAS must be digitalized and managed by Local Area Network (LAN). For this, Thyroid Disease Management works will be maintained by Local Area Network. Smoothly at INMAS this paper describes the Implementation of Local Area Network in Thyroid Disease Management at INMAS, Dhaka.

2. Attended in Seminar/Symposium/Conference/Workshop/Meeting

- i. Natural Language Processing and Machine Learning Approches to Detect Bangla Speech on Social Media on 2023 26th International Conference on Computer and Information Technology (ICCIT) dated on 12th December 2023. Attended by Md. Haidar Ali, Senior Scientific Officer, Md. Mahbub Alam, Senior Scientific Officer, CSND, ICS.
- ii. Intregrated Digital Service Delivery Platform User Acceptance Test dated : 8-14 May, 2023. Attended by Md. Mahbub Alam, Senior Scientific Officer, CSND, ICS.
- iii. Meeting about National Single Window to modernize Import/Export facilities of Bangladesh. Dated : 08 January, 2023. Attended by Md. Mahbub Alam, Senior Scientific Officer, CSND, ICS.

Workshop on Usage of E-Participation tools on National Web Portal organized by a2i, Ministry of ICT. Dated: 24 March 2024. Attended by Md Haidar Ali, Senior Scientific Officer, CSND, ICS.

3. Service Rendered

3.1 Assemble, Troubleshooting, Repair and Maintenance of PC

A number of new computers have been assembled for ICS as well as other institutes of BAEC. Beside this, 51 computers have been repaired and upgraded during this period. A list of these activities for the period of July 2023 to June 2024 is given below:

SL. No	Name of the Institute	No. of PC
1.	Institute of Nuclear Science and Technology (INST), Savar	25
2.	Institute of Food and Radiation Biology (IFRB), Savar	15
3.	Institute of Computer Science (ICS), Savar	05
4.	Nuclear Mineral Unit (NMU), Savar	05

5.	Central Administrative Division (CAD), Savar	04
6.	Central Finance & Accounts Division (CF&AD), Savar	04
7.	Scientific Information Unit (SIU), Savar	02
8.	Institute of Radiation & Polymer Technology (IRPT), Savar	02
9.	Training Institute , (TI)Savar	04
10.	Central Engineering Facility (CEF), Savar	05

3.2 Preparation of ID card

The Official ID card for each employee working in BAEC is prepared by Computer System Division, Institute of Computer Science. In July 2023 to June 2024 more than 238 ID cards have been prepared by Computer System Division from different Institutes/Divisions in BAEC.

SL. No	Name of the Institute	No. of Card
1.	Institute of Nuclear Science and Technology (INST),Savar	20
2.	Institute of Food and Radiation Biology (IFRB) ,Savar	15
3.	Institute of Electronics (IE) ,Savar	10
4.	Institute of Computer Science (ICS) ,Savar	10
5.	Central Engineering Facility (CEF) ,Savar	05
6.	Institute of Nuclear Mineral (INM) ,Savar	05
7.	Central Administrative Division (CAD) ,Savar	07
8.	Central Finance & Accounts Division (CF&AD) ,Savar	08
9	Institute of Energy Science (IES), AERE, Savar	05
10.	Institute of Tissue Banking and Biomaterial Research (TBBR), Savar	10
11.	Center for Research Reactor (CRR) , Savar	08
12.	Scientific Information Unit (SIU) ,Savar	05
13.	Institute of Radiation & Polymer Technology (IRPT) ,Savar	10
14	Training Institute ,(TI) Savar	05
15.	Medical Physics	15
16.	Daily Basis Employee, AERE,Savar	15
17.	Visitor Pass, AERE, Savar	10
18.	BAEC Head Quarter, Dhaka	10
19.	Atomic Energy Center, Dhaka	15
20.	Institute of Nuclear Medicine & Ailed Sciences (INMAS), Rajshahi	15
21.	National Institute of Nuclear Medicine & Ailed Sciences(NINMAS),Shahbag , Dhaka	15
22.	National Institute of Nuclear Medicine & Ailed Sciences (NINMAS), Dhaka	15

3.3 Internet (Broadband) Service

Assemble, Installation, New Connection, Fiber Splicing, Troubleshooting, Repair and Maintenance of Network devices/Internet Connection for ICS as well as other Institute of BAEC. Beside this, 900 Network devices/Internet Connection have been installing with configure Wi-Fi router, Switch, Replace Connector, Cabling, New Internet Connection, Fiber Splicing, Troubleshooting, Repair and Maintenance etc of during this period. A List of this activities for the period of July 2023 to June 2024 is given below:

SL. No	Name of the Institute	No. of Card
a.	Institute of Nuclear Science and Technology (INST),Savar	95
b.	Institute of Food and Radiation Biology (IFRB) ,Savar	78
c.	Institute of Electronics (IE) ,Savar	29
d.	Institute of Computer Science (ICS) ,Savar	27
e.	Central Engineering Facility (CEF) ,Savar	17
f.	Institute of Nuclears (INM), Savar	19
g.	Central Administrative Division (CAD) , Savar	75
h.	Institute of Energy Science (IES), AERE, Savar	19
i.	Institute of Tissue Banking and Biomaterial Research (ITBBR),Savar	17
j.	Center for Research Reactor (CRR) ,Savar	10
k.	Scientific Information Unit (SIU) , Savar	07
l.	Training Institute (TI) ,Savar	31
m.	Institute of Radiation & Polymer Technology (IRPT) ,Savar	19

n.	Savar, Quarter	39
o.	BAEC Head Quarter, Dhaka	355
p.	Atomic Energy Center, Dhaka	110

Software Engineering Division (SED)

Objective

The Software Engineering Division (SED) is mainly responsible for all aspects of nuclear software system from the early stages of system specification through to analysis, design, development and maintaining the system after it has gone into use. In addition, this division is continuing research and development in the field of building knowledge-based expert system to full-fill the goal of Digital Bangladesh, nuclear knowledge management system, e-learning, computer security, mining nuclear knowledge, software development meeting scientific and computation need, data acquisition and analysis, computer simulation and modeling, artificial intelligence and internet of things (IOT), developing database system for storing and processing nuclear data, facilitating paperless administrative work in BAEC, developing ICT based applications/tools to provide hassle-free scientific and other services to the mass people and doing research work in the upcoming technologies.

Activities

1. R&D work(s)

1.1 The Diverse Advantages of Virtual Reality in Research

N. K. Datta, M. M. Alam

Virtual reality refers to a computer-generated simulation that creates an artificial environment for users. By wearing a VR headset, users can step into a virtual world that looks and feels real, complete with 3D graphics, sound, and even physical interaction.

Incorporating VR into research brings a range of significant benefits that advance scientific investigation and comprehension:

Advanced Simulations: VR offers researchers high-quality simulations that facilitate the study of human behavior in a lifelike virtual environment. This technology enables the creation of intricate and realistic scenarios for experiments, which might be too expensive or unfeasible to replicate in reality, such as natural disasters or historical events.

Consistency in Experiments: VR allows for the exact replication of specific experimental conditions, which is essential for validating scientific research. This capability ensures that different researchers can reproduce experiments and verify results, enhancing the reliability of the findings.

Innovative Data Gathering: VR provides a unique approach to collecting extensive data by integrating visual and auditory stimuli with biometric sensors. These sensors monitor eye movements, heart rate, and other physiological responses, offering a comprehensive perspective on how participants react to various stimuli.

Improved Accessibility and Ethical Research: VR technology makes it possible to explore scenarios that are either unreachable or unethical to reproduce in real life. This includes studying phenomena like extreme weather or social interactions under high stress without any real-world dangers.

Increased Participant Engagement: The immersive quality of VR enhances participant involvement, resulting in more genuine responses and richer data for researchers.

1.2 Big Data Analytics: What It Is, How It Works, Benefits, And Challenges

N. K. Datta, M. M. Alam

Big data analytics describes the process of uncovering trends, patterns, and correlations in large amounts of raw data to help make data-informed decisions. These processes use familiar statistical analysis techniques—like clustering and regression—and apply them to more extensive datasets with the help of newer tools. Big data has been a buzz word since the early 2000s, when software and hardware capabilities made it possible for organizations to handle large amounts of unstructured data. Since then, new technologies—from Amazon to

smartphones—have contributed even more to the substantial amounts of data available to organizations. With the explosion of data, early innovation projects like Hadoop, Spark, and NoSQL databases were created for the storage and processing of big data. This field continues to evolve as data engineers look for ways to integrate the vast amounts of complex information created by sensors, networks, transactions, smart devices, web usage, and more. Even now, big data analytics methods are being used with emerging technologies, like machine learning, to discover and scale more complex insights.

To get better understanding, let's break it down into key steps:

- Data Collection
- Data Cleaning (Data Preprocessing)
- Data Processing
- Data Analysis
- Data Visualization
- Data Storage and Management
- Continuous Learning and Improvement

Some benefits of big data analytics include:

- Cost savings. Helping organizations identify ways to do business more efficiently
- Product development. Providing a better understanding of customer needs
- Market insights. Tracking purchase behavior and market trends

Big data brings big benefits, but it also brings big challenges:

- Making big data accessible.
- Maintaining quality data.
- Keeping data secure.

Finding the right tools and platforms.

1.3 Development of General Provident Fund (GPF) Management System

N. K. Datta, M. M. Alam

Recently, The government has fixed the profit rate of the General Provident Fund (GPF). From now on, the government employees in contributions to the GPF and the CPF will get interest at the rate of 11 to 13 percent at three levels, which was at 13 percent for so long. According to the new guidelines, in the 2021-22 financial years, the initial rate of GPF will be up to tk. 15 lakh and the profit rate will be 13 percent. The profit rate from Tk. 15 lakh to tk. 30 lakh has fixed at 12 percent. If the initial GPF is more than tk. 30 lakh, the profit rate will be 11 percent. The rate of return on investment up to tk. 15 lakh has not changed. In this regard, we have focused on the development and implementation of the GPF management system that could fulfill the new guidelines.

1.4 Contents Management, Up-gradation and Uploading of the Official Web Portal of BAEC

N. K. Datta, M. M. Alam

A content management system (CMS) is a software application or set of related programs that are used to create and manage digital content. The website of BAEC is to reflect the activities of different institutes in Bangla as well as in English. All types of up-gradation like notice board, NOC,

All types of notices of BAEC on the notice board are updated on the web portal. As a result, everybody can know about notices very easily and able to simplifies official activities and accelerates the activities stated in the notice. These service providing activities are routine work as well as continuous activities of this division. NOC of Officers and staffs for passport that is approved by the BAEC are updated in the web portal. As a result, getting and processing passport from passport office have become easier and faster. Besides those, Recruitment Result, Ex Bangladesh earn leave, different “Service box” are updated on the due time. Transfer order, Tender, Annual Performance Agreement (APA), National Integrity Strategy Action Plan etc. are done according to the request of the higher authority. Several requests notes have been sent to SID,HQ to get updated information/photo of different institutes/divisions of BAEC.

1.5 Management and Maintenance “Directory of Personnel” of BAEC

N. K. Datta, M. M. Alam

BAEC maintain an employee database where all scientists, Engineers, Doctors and Geologists are on recorded according to institute. Newly appointed employees are added on the database and any up-gradation process is done in the nick of time. To track the employee faster, add new employees in simple steps, Update or Modify details easily, filter and track the employee faster. According to official order of BAEC any posting/newly recruitment/deletion of scientist are done at the due time on the “Directory of Personnel” of BAEC.

1.6 Management and Maintenance of Foreign Visit Records Web-based Software of BAEC

N. K. Datta, M. M. Alam

Scientists of BAEC travel to abroad to attend in seminars, symposium and training for different official purposes. Foreign visit database aims to store overall information of each and every visit of the scientists. BAEC maintain a Foreign Visit database where all international Seminar/ Symposium/ Conference/ Workshop/ Meeting attended by the employee of BAEC are recorded. We provide technical support on any problem to enhance this activity.

There are features available to search list of event participation of any specific scientist or all the participants of any specific event. It is also possible to search participants or events of any specific month of any year. In any specific visiting history, it shows the name of the event, duration, participant’s details including designation and institute. If any problem occurred during maintain the normal activities of this software we provide technical support.

1.7 Others

- i. Software Development: Management Information System (MIS)
- ii. Software Development: General Provident Fund(GPF)

2. Manpower Development

Sl. No	Title (Training program/Workshop/Seminar/ Symposium/ Conference)	Date	Place	No. of Participant
1.	Steps to meet the challenges of the 4 th industrial revolution and VR Facilities Development	06/06/2024	ICS	15

3. Seminar/Symposium/Conference/Workshop/Meeting Attended

Name of the Participant	Title of the event	Organizer	Date	Place
Engr. Nayan Kumar Datta	26th International Conference on Computer and Information Technology (ICCIT)	IEEE, Bangladesh	13-15 Dec. 2023	Cox's Bazar, Bangladesh
Dr. Md Mahbub Alam	International Conference on Nuclear Knowledge Management and Human Resources Development	IAEA	1-5 July 2024	Vienna, Austria

4. Academic Activities

Project supervision of an undergraduate student.

Project title: “Design and Development of Journal Management System”

5. Service Rendered

Sl. No.	Name of the Services	Nature of sample/service	Total number/quantity of sample/person/ patient
1.	Management and Maintenance Official Web-portal of BAEC	ICT Based Expert Servicers	As per required
2.	Contents Uploading at the Official Web-portal.	ICT Based Expert Servicers	About 350

3.	Management and Maintenance Directory of Personnel of BAEC.	ICT Based Expert Servicers	About 200
4.	Management and Maintenance Foreign Visit Records Web-based software of BAEC.	ICT Based Expert Servicers	About 4

Nuclear Cyber Security Division (NCSD)

Objective

The Nuclear Cyber Security Division (NCSD) is dedicated to advancing both basic and applied research in nuclear cyber security, computer network and information security, and cyber-physical infrastructure, all while integrating cutting-edge 4th industrial technologies. In addition to its research endeavors, NCSD offers specialized training in security-related issues and cyber security awareness, contributing to the development of human resources at BAEC. The division actively shares its findings through articles in peer-reviewed journals, conference proceedings, and participation in international and national seminars and workshops.

Beyond research and training, NCSD provides essential ICT services to BAEC, including official email services under the BAEC domain, Management Information Systems, D-Nothi services, and the development, maintenance, and upgrading of software, web applications, and inter-network infrastructure. The division ensures core-level network security and focuses on manpower development. Today, NCSD also addresses the information and cyber security needs of the Atomic Energy Research Establishment by successfully implementing Firewall services.

Under NCSD's supervision, a data center is currently being established to enhance data security and support the digitalization of various activities for the Commission. Additionally, NCSD has developed Moodle-based e-learning management software to promote human resource development and raise nuclear cyber security awareness among the public. The division also plays a critical role in implementing and administering a secure D-Nothi system at BAEC.

Activities

1. R&D work(s)

1.1 Research on Nuclear Cyber Security and Network Security at BAEC

M. S. Islam, K. N. S. Mitu, M. D. Hossain

ICS oversees the design, development, and implementation of network systems, including LAN and Wi-Fi, at BAEC HQ, AERE, and AECD. These networks connect numerous computers and digital control systems, both publicly and privately. With the ever-evolving landscape of nuclear cyber security and network security, new threats and technologies emerge regularly, making it a challenging task to ensure the security of these networks, particularly those involving nuclear-related digital control systems. Researchers in the Nuclear Cyber Security lab are dedicated to staying ahead of cyber adversaries, continuously enhancing security measures to protect critical infrastructure and sensitive data.

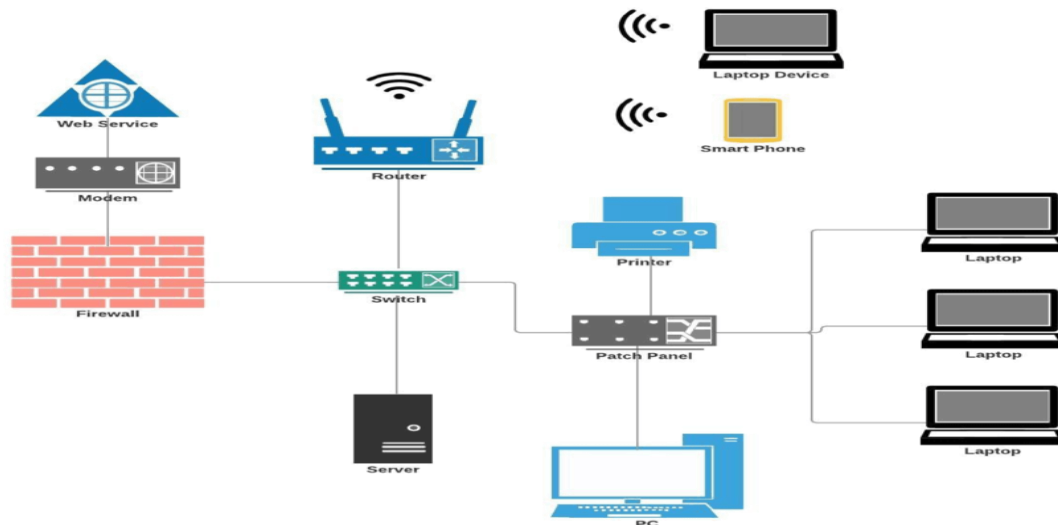


Fig 1. AERE Internal network System

At present, CISCO next-generation hardware firewall has been implemented at ICS network server room, AERE as part of ensuring the core network security. This firewall is running under the supervision of NCSD division.

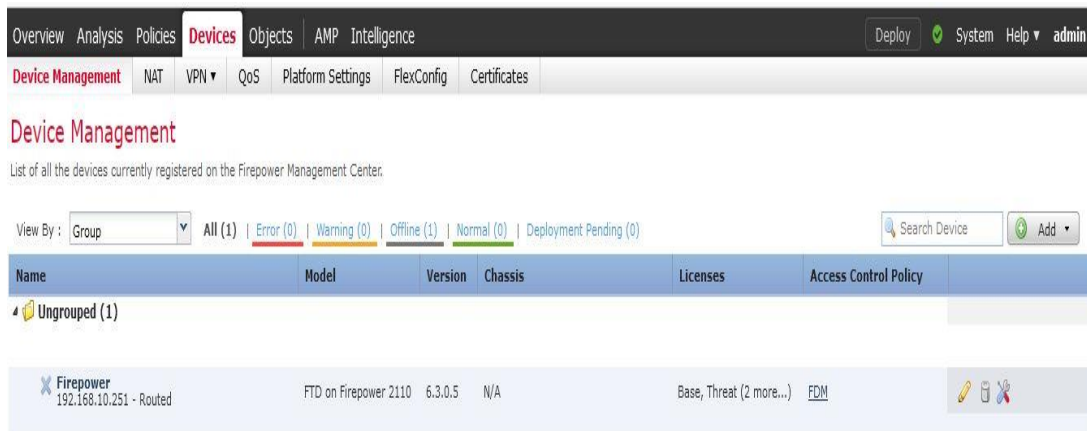


Fig 2. AERE Active Network Monitoring System

1.2 Expansion of the Moodle-Based E-learning Management System at BAEC

M. S. Islam, M. D. Hossain

BanglaThe Bangladesh Atomic Energy Commission (BAEC) provides a range of training and short courses for its employees and students, including specialized training, industrial attachment programs, and various short- and long-term courses related to nuclear activities. To streamline these educational offerings, a Moodle-based E-learning Management System has been developed on the NCSD division's local server within the ICS network. Expanding this Moodle-based LMS at BAEC involves upgrading its features, functionalities, and content to enhance the overall learning experience for both students and instructors.

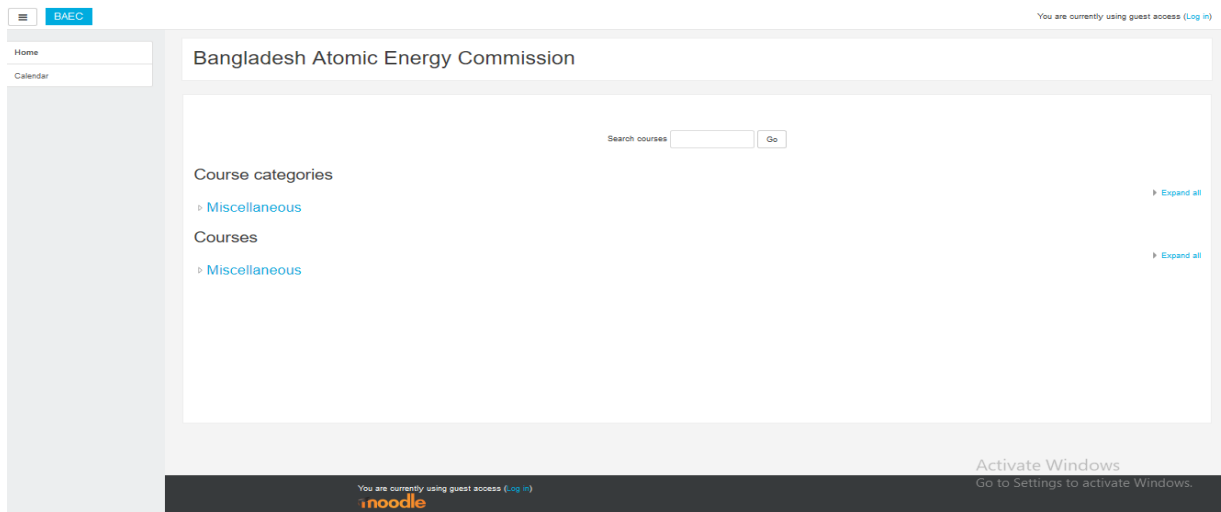


Fig 3. Moodle Based E-Learning Management System at BAEC

1.3 Research on Nuclear Knowledge Management System

M. S. Islam, M. D. Hossain

Bangladesh Atomic Energy Commission (BAEC) is a multidisciplinary research organization. In response to current needs, Nuclear Knowledge Management (KNM) has become a key research focus within the NCSD lab. A Nuclear Knowledge Management System is a comprehensive strategy for capturing, organizing, preserving, and sharing knowledge within the nuclear industry. It involves systematically managing information related to nuclear technology, safety, research, operations, and best practices to support informed decision-making and improve overall performance.

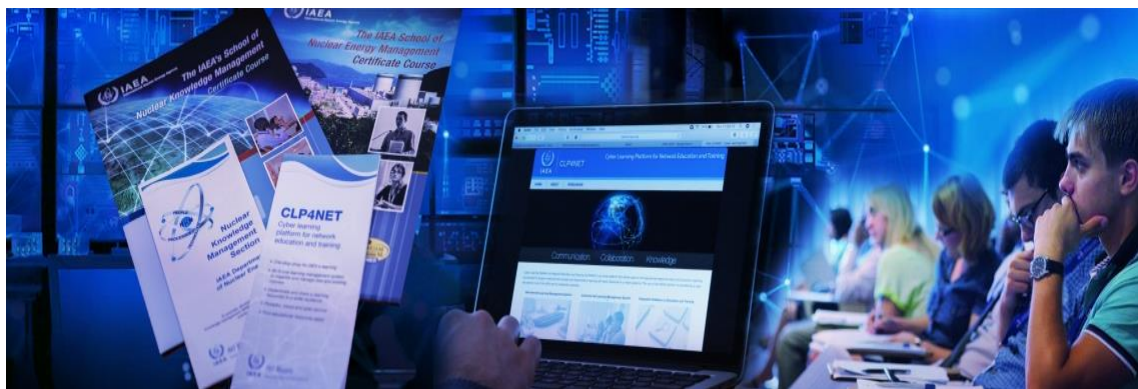


Fig 4. Nuclear Knowledge management System section

1.4 A Private Cloud Configuration to Meet-up the 'Big Data' Challenges of BAEC and its Establishments

K. N. S. Mitu, M. S. Islam, M. D. Hossain

Current and upcoming era is the era of Big Data, where it comes along with challenges between Big Data storage, processing and security that raises problems. On one side, the large amount of trust related data must be highly available, flexible, and fast processing and on the other side, the trust and security of Big Data are the challenges.

No doubt, various types of BAEC data such Biological Data, Medical Record Data, Physical Data, etc. can strengthen the 'Big Data' concept in the context of data collection point of view. According to the present-day information security crisis there is an extreme need for the storage and management of the trust-worthy data through the private cloud adoption.

This proposal highlights the challenges of Big Data management in the context of BAEC establishment and

present a private cloud storage solution to meet up these challenges for the BAEC and its establishments through the efficient design, development, and implementation. This study also discusses the capabilities of the private cloud storage as it is more superior to public cloud for Big Data storage and for the Information Security.

Cloud Cost Analysis

For example, BAEC is planning to deploy initially a 15x node OpenStack cluster with 100 TB of raw storage capacity and 5 TB of memory in a new site- **tier III standard private cloud setup**

Private data centre CapEx Costs

Building a private data centre requires a lot of expertise and support from multiple third-party suppliers such as the facility preparations, HVAC, power, safety, security and skilled labor. A tier III data centre facility will be examined as a Use Case and can be described as a concurrently maintainable data centre with N+1 redundancy, with no expected downtime for planned maintenance or hardware replacement.

We only listed some of the important metrics to calculate the capital cost of a private cloud setup under some headers instead of the actual amount. As this is an ongoing research activity of Nuclear Cyber Security Division (NCSD), the private cloud configuration for BAEC will be implemented at any selected location and the appropriate cost analysis will take place in future study. There are ongoing future research are in place to do discuss more on the security of cloud in a virtualized environment and how to handle more in coming data into cloud regardless of private or public cloud. The authors of this work are also concerned to put effort in this issue as their future work.

1.5 Implementation D-Nothi System at BAEC and its Regional Offices

Md. S. Islam, M. A. Uddin, M. D. Hossain

BAEC and its regional offices have recently transitioned from the e-Nothi System to the D-Nothi System. The D-Nothi System has undergone several updates and changes to meet evolving needs and is entirely modular. The implementation of the D-Nothi System at BAEC and its regional offices has been overseen by the Institute of Computer Science. Within this system, an administrator from the NCSD division of ICS plays a crucial role in both its implementation and administration. This administrator is responsible for integrating employees into the system, processing resignations based on directives from higher authorities, editing Nothi headings, correcting errors, and providing training to employees, among other related tasks.

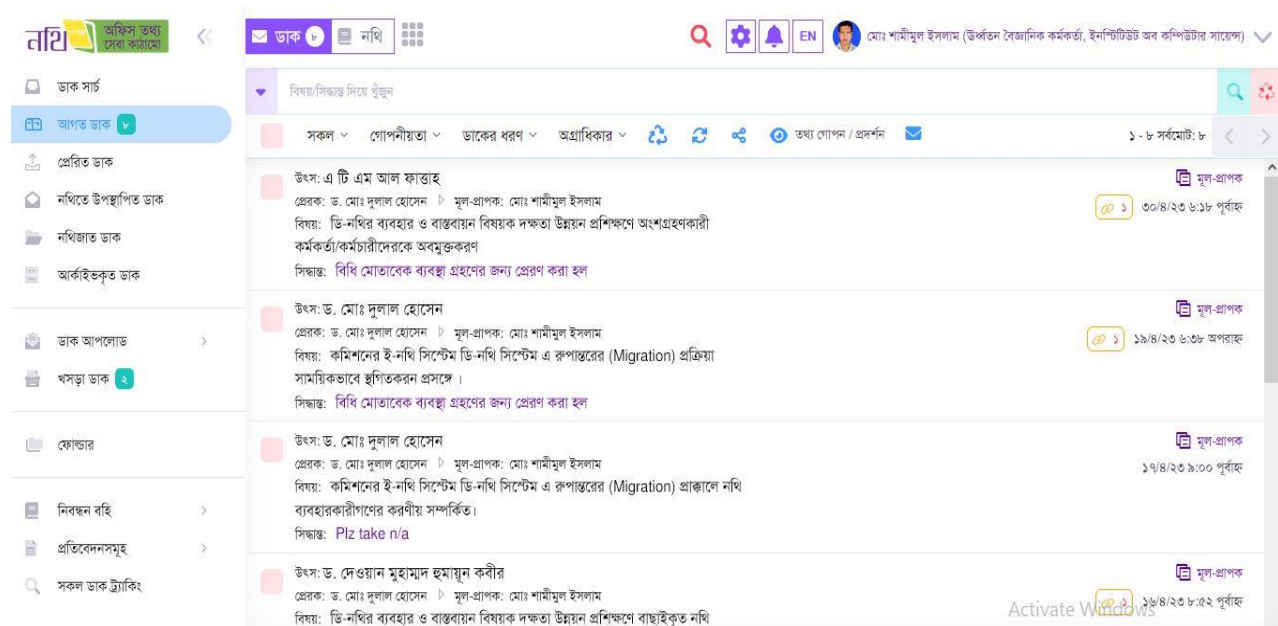


Fig.5- Overview of D-Nothi System

2. Manpower Development

a)	D-Nothi Office Management System at BAEC	20-21 June 2023	BAEC HQ	25

3. Service Rendered

Sl. No.	Name of Service Provided	Number/Quantity of Service Provided
a)	BAEC Domain based Official Email Services	538
b)	Management Information System Administration Services	408
c)	D-Nothi Administration Services	725
d)	Consultation to the Scientists on the Computer and ICT	480
e)	Wi-Fi Internet Security Services	650

INSTITUTE OF ENERGY SCIENCE (IES), AERE

Objective

Bangladesh Atomic Energy Commission is struggling on reinforcing its culture of innovation with un-relented commitment to face the energy challenges of Bangladesh in the new millennium. Energy is the strategic input for sustainable development, and the issue of energy security is considered like the individual, social, and territorial security. Institute of Energy Science started functioning on April 2008 at the Atomic Energy Research Establishment campus to build a favorable infrastructure for sustainable energy research and to promote the technological know-how in both renewable and non-renewable energy fields. The planned research and development activities are diverse and broad and the main objectives are to

- build trained and skilled manpower in different areas related to energy production
- undertake and promote R&D activities in the respective fields
- develop new technology for efficient and cost-effective energy production
- perform R&D in renewable sources, including hydrogen energy
- support academic activities, such as M.Sc., M.Phil., Ph.D. studies, and carry out collaborative research programs

1. R&D work(s)

1.1 Customization and Application of Decision Support System JRODOS for Nuclear and Radiological Safety Problems of VVER-1200 Nuclear

S.M.T. Hassan, M.A. Khaer, M.T. Chowdhury, M.M. Rahman

A code was developed in Visual Basic programming language to generate an XML file following the RODOS format from the provided source term data in Microsoft Excel Spreadsheet, which can be directly used in JRODOS (Java-based Real-time On-line Decision Support) platform. A simple source term model was used to check the applicability of the code. Finally, the code was successfully implemented to reproduce the JRODOS formatted XML file of a rigorous source term for a given Fukushima Dai-ichi nuclear power plant accidental scenario. Therefore, the developed code eases a vital analysis step, which can otherwise be very cumbersome, especially for a detailed source term scenario involving many radionuclides, release intervals, and release heights of a nuclear accident. Another code was developed to collect and download the meteorological data for atmospheric dispersion analysis from the server of the National Centre for Environmental Information (NCEI), USA. Accidental scenarios depicting Loss of Coolant Accident (LOCA) and Station Blackout (SBO) have also been developed. Using the design parameters and source-term of the VVER-1200 reactor along with the meteorological data the postulated accident has been analyzed. Air concentration, surface deposition, and radiological dose parameters have been collected and assessed. Based on radiological consequences emergency planning zones have been suggested.

1.2 The Study of Hypothetical Core Damage Accidents of the TRIGA Mark-II Research Reactor of Bangladesh

M.A. Akter, M.A. Khaer, S.M.T. Hassan, M.T. Chowdhury, M.M. Rahman

The objective of this study was to evaluate the radiological impact of a hypothetical severe accidental condition at the TRIGA Mark-II research reactor in Bangladesh during both winter and rainy seasons. The research involved deriving the source term, assessing atmospheric dispersion characteristics, and evaluating the dose to different organs. An inventory of peak radioisotope activities released in the core was analyzed using the Gaussian plume equation, which identified 32 dominant radionuclides. The total activity of isotope *i* released in the atmosphere was $2.15\text{E}+14$ Bq and $4.30408\text{E}+14$ Bq and amount of isotope *i* contained in the fuel was $4.57529\text{E}+16$ Bq and $9.15057\text{E}+16$ Bq were performed based on a postulated scenario of 50% core damage and 100% core damage. The health physics code, HotSpot 3.1.2, was used to perform the atmospheric transport modeling which was then applied to calculate the total effective dose and how it would be distributed to human organs as a function of distance downwind for both winter and rainy seasons. Radiological doses such as TED, Thyroid CDE, and Inhalation CED have been evaluated on a local scale of about 80 km for HotSpot and, utilizing the Gaussian Plume model and for effluents released in various downwind distances depending on several parameters such as the released radioactivity, the weather conditions, the atmospheric stability classes, etc. It is observed that ground shine dose is very high in the accident site in rainy season (figure 5.16) which $2.78\text{E}0-1\text{Sv}$ at 0.03km and decrease as function of distance up to 10km and comparatively quickly decrease after 10km. Such high ground shine dose may be appear due to the large ground surface deposition $8.50\text{E}6\text{kBq/m}^2$ at 0.03km. Other two pathways follow the same tendency. Here submersion shows the lowest contribution as low as $2.23\text{E}-4$ Sv at 0.3km. The highest dose was estimated as $4.17\text{E}-3$ Sv, $2.71\text{E}-4$ Sv and $1.22\text{E}-3\text{Sv}$ for inhalation submersion and ground shine respectively. However, the radiation doses calculated in all cases exceed the permissible limit, therefore, immediate radiological protective measures such as sheltering, evacuation, and administration of prophylactic drugs are necessary based on the guidelines of the national regulatory authority.

1.3 Radiological Impact Assessment for a Hypothetical Accident at RNPP Considering Loss of Coolant and Long-term Station Blackout Accidents

S.S. Hossain, M.A. Khaer, S.M.T. Hassan, M.T. Chowdhury, M.M. Rahman

The focus of our study was on the radiological safety and emergency response protocols of the VVER-1200 type nuclear power plant. The computational code RASCAL 4.3 was used to analyze long-term station blackouts (LTSBO) and loss of coolant accidents (LOCA) during six different seasons in Bangladesh. Radiological doses were measured at a radial distance of 40 km from the reactor site. The total effective dose equivalent (TEDE), thyroid committed dose equivalent, child thyroid committed dose, ground shine dose, and inhalation doses were assessed in this analysis. The RASCAL 4.3 code predicted a larger total effective dose during the rainy season in comparison to the other five seasons. The results indicate that the rainy season dose values exhibited a sharper decreasing pattern compared to the other seasons for both LOCA and LTSBO. The dose values of LTSBO are higher than those of LOCA at every distance in every season. Finally, the calculated TEDE and child thyroid doses were compared to the U.S. Environmental Agency's early-phase dose criteria. The evacuation distances for LOCA were estimated at 6 km to 8.3 km, while the sheltering distances were at 10 km to 12 km. On the other hand, the evacuation distances were predicted at 7.2 km to 8.7 km, and the sheltering distances were 12.2 km to 13 km for LTSBO. Therefore, the local regulatory body should promptly implement radiological protective measures in accordance with the established emergency response plan.

1.4 Atmospheric Dispersion and Radiological Impact Analysis due to a Single Fuel Rod Failure in the TRIGA Mark-II Research Reactor in Bangladesh

Z.T. Lubna, M.A. Khaer, S.M.T. Hassan, M.T. Chowdhury, M.M. Rahman

This study focuses on the radiological safety and emergency preparedness of the TRIGA Mark-II research reactor. It investigates the radiological consequences of a novel catastrophic accident scenario in which a single fuel rod is destroyed while the majority remain intake. The study evaluates source-term, which refers to the amount of radioactive materials released into the atmosphere, under continuous operation of 365 days

operation at 3 MWth power level. Using the Gaussian plume model via the HotSpot code, the atmospheric dispersion of radionuclides has been simulated, considering both dry and rainy seasons. The project aims to calculate the Total Effective Dose (TED) and thyroid effective dose to assess the health impacts on nearby populations and inform necessary emergency response measures such as evacuation, sheltering, and iodine prophylaxis. By analyzing core inventory and source term, and simulating dispersion properties, this research provides critical insights and recommendations for reactor operators, regulatory bodies, and emergency management organizations to enhance reactor safety and mitigate radiological risks.

2. Manpower Development (Training /Fellowship/Workshop/Meeting)

2.1 Attend in Training/Fellowship/Workshop/Meeting

Sl. No	Title of the program	Date	Place	Name of participants
1	IAEA technical meeting- Case study on Nuclear Hydrogen systems: Drivers and Institutional, Economic and Legal Impediments (INPRO Hydrogen Study)	14-17 May, 2024	Virtual Platform	Dr. Mohammad Mizanur Rahman

5. Oral/Poster Presentation in Seminar/Symposium/Conference(National and International)

Name of the Participant	Title of oral/poster presentation	Title of the event	Organizer	Date	Place
S.M. Tabirul Hassan	Regional Scale Atmospheric Analysis using MATCH Model due to Release of Radionuclides from the Fukushima Dai-Chi Nuclear Power Plant	International Conference on Physics-2024	Bangladesh Physical Society	09-11 May, 2024	AECD, Dhaka, Bangladesh
Md. Abu Khaer	A Study on the Radiological Impact of a Hypothetical Accident at Bangladesh's TRIGA Research Reactor	International Conference on Physics-2024	Bangladesh Physical Society	09-11 May, 2024	AECD, Dhaka, Bangladesh
FaoziaSilvee	Study of Radiological Impact Due to Accidental Release of Significant Radionuclides Considering Various Weather Conditions from the TRIGA Research Reactor of Bangladesh	BCSIR Congress-2023	Bangladesh Council of Scientific and Industrial Research	8-10 March, 2024	BCSIR, Dhaka, Bangladesh
Mohammed Tareque Chowdhury	A Novel Method to Extract Optical Constants from the optical Transmittance Spectra of the CdSe thin Film	International Conference on Physics-2024	Bangladesh Physical Society	09-11 May, 2024	AECD, Dhaka, Bangladesh
S.M. Tabirul Hassan	Regional Scale Atmospheric Analysis using MATCH Model due to Release of Radionuclides from the Fukushima Dai-Chi Nuclear Power Plant	Seminar	Institute of Energy Science	20 May, 2024	IES, AERE, Savar, Dhaka
Md. Abu Khaer	Study the Core Damage Accident of the TRIGA Mark-II Research Reactor and Atmospheric Dispersion of Radionuclides	Seminar	Institute of Energy Science	11 June, 2024	IES, AERE, Savar, Dhaka

6. Collaboration work/MOU (ADP/FNCA/MEXT/FTC/IAEA/RCA/TC/S&T/CRP/In-house project, Universities, etc.)

6.1 S&T

Customization and Application of Decision Support System JRODOS for Nuclear and Radiological Safety Problems of VVER-1200 Nuclear

Principal Investigator: Dr. Mohammad Mizanur Rahman, Associate Investigator: S.M. Tabirul Hassan, (Project ID: SRG-236616, Financial year: 2023 – 2024)

A code was developed in Visual Basic programming language to generate an XML file following the RODOS format from the provided source term data in Microsoft Excel Spreadsheet, which can be directly used in JRODOS (Java-based Real-time On-line Decision Support) platform. A simple source term model was used to check the applicability of the code. Finally, the code was successfully implemented to reproduce the JRODOS formatted XML file of a rigorous source term for a given Fukushima Dai-ichi nuclear power plant accidental scenario. Therefore, the developed code eases a vital analysis step, which can otherwise be very cumbersome, especially for a detailed source term scenario involving many radionuclides, release intervals, and release heights of a nuclear accident. Another code was developed to collect and download the meteorological data for atmospheric dispersion analysis from the server of the National Centre for Environmental Information (NCEI), USA. Accidental scenarios depicting Loss of Coolant Accident (LOCA) and Station Blackout (SBO) have also been developed. Using the design parameters and source-term of the VVER-1200 reactor along with the meteorological data the postulated accident has been analyzed. Air concentration, surface deposition, and radiological dose parameters have been collected and assessed. Based on radiological consequences emergency planning zones have been suggested.

Period: July, 2023 - June, 2024

6.2 MoU

A MoU (Memorandum of Understanding) between the Institute of Energy Science, Bangladesh Atomic Energy Commission, Bangladesh and the Institute for Integrated Radiation and Nuclear Science, Kyoto University, Japan has been signed by the BAEC and the Kyoto University

The two parties agree to promote academic and research exchange between them in the field of nuclear engineering, particularly in the areas of thermal hydraulics and safety.

Period: 20th December, 2021- 19th December, 2024

INSTITUTE OF RADIATION AND POLYMER TECHNOLOGY (IRPT), AERE

Objective

Institute of Radiation and Polymer Technology (IRPT) is devoted to innovative research and development work by the direct utilization of radiation processing technologies. The foundation of the Institute was built up in 2010 and has been capable, through creative research and technological accomplishments in polymer science and industrial use of gamma radiation sterilization process to add to the national development goal for obtaining self-sufficient economy. The Institute has the 350 kCi Co-60 gamma source which is the largest capacity source in Bangladesh.

The main objectives of the institute are

- Application of radiation processing technologies for the socio-economic development of the country.
- Providing commercial gamma irradiation services for quality improvement of food items and sterilization of medical products, pharmaceutical raw and packaging materials etc.
- To provide irradiation service to research organizations for R & D purpose.
- To expand cooperation with other scientific organizations, universities, private and public sectors through mutual exchange of educational programs, training, technical cooperation and expert services.
- To develop human resources in the field of nuclear science and technology.
- Transferring the technology to the entrepreneurs for industrial applications.

Activities

1. R&D work(s)

- a) Radiolysis synthesis of nano materials was done and the effect of gamma (γ) radiation on them was examined.
- b) **Development of advanced materials for biomedical, environment application:** Different types of hydrogels were prepared for biomedical application and heavy metal removal.
- c) **Use of radiation, chemical and microbiological tools for water treatment for different uses:** Physio-chemical and microbiological quality assessment of surface water of different rivers and aquaculture pond in Savar, Dhaka was conducted. Gamma irradiation was used for the treatment of polluted river water. Research was conducted to investigate naturally occurring bacterial strategy in degrading or detoxifying heavy metals. Study was conducted in a view to removal of chromium and lead from paint industry effluent by naturally occurring bacteria. Biodegradation capability of pesticide resistant naturally occurring bacteria to breakdown the hazardous residual pesticide was also observed.

Dye sensitized Solar Cells (DSSCs) were constructed with NiO and ZnO nanoparticles and the effect of gamma (γ) radiation on them was determined.

4. Green synthesis of CuO nano materials was done and the effect of gamma (γ) radiation on them was examined.

- i) **Repair & Maintenance, Renovation works, etc.**

- Repair and maintenance of UTM machine and started working properly.
- Repair and maintenance of Uv-Vis machine and started working properly.
- The capacity of the demineralized water treatment plant is 1000L/hr which was checked properly.

Repair and maintenance work were done for Heat Press Molding Machine of Composite Lab of IRPT.

5. Manpower Development(Training program/workshop/Seminar/Symposium/Conference arranged)

Name of the Participant	Title of the Event	Organizer	Place	No. of Participants
Dr. Ruhul Amin Khan, Director, IRPT	Effect of gamma radiation on fiber reinforced polymer composite	21 August, 2023	Seminar Room, IRPT, Savar, Dhaka	15
Md. Mukul Hossain SSA, IRPT	Dosimetry for gamma irradiator	21 November, 2023	Seminar Room, IRPT, Savar, Dhaka	14

6. Seminar/Symposium/Conference/Workshop/Meeting Attended

Name of the Participant	Title of the Event	Organizer	Date	Place
Dr. Ruhul Amin Khan, Director, IRPT	International Food ionizing Processing symposium	IAEA	26-28 September, 2023	Dallas, Texas, USA
Dr. Ruhul Amin Khan, Director, IRPT	The pre-shipment inspection visit programme of Co-60 source	Russia	15-20 October, 2023	JSC, NITFA, Rosatom
Dr. Ruhul Amin Khan, Director, IRPT	The final project review meeting	IAEA	30 October- 03 November, 2023	Hanoi, Vietnam
Dr. Abu Kashem Mohammad Moshikul Alam, PSO, IRPT	Workshop on Supporting the Adoption of Electron Beam Technology and its Applications in Areas of Food and Agriculture, Industry, Human Health and Environment treatment	ORS, USA	15-19 April, 2024	Texas, USA

7. Stakeholder Meeting

Several stakeholder meetings were held with different companies e.g. Pran Agro Ltd., Square Food and Beverage Ltd. Etc. for promoting irradiation services to these stakeholders from July 2023 to June 2024 at IRPT.

Title	Place	Date
Experience Sharing Meeting with Stakeholders	Seminar Room, IRPT, AERE, Savar, Dhaka.	13December, 2023
Experience Sharing Meeting with Stakeholders	Seminar Room, IRPT, AERE, Savar, Dhaka.	11March, 2024

10. Service Rendered

The 350 kCi Co-60 gamma irradiator of IRPT is used to irradiate food items, medical and pharmaceutical products. Generally, 25 kGy is used for sterilization purposes and up to 10 kGy is applied for food items. In this institute, different private companies take food irradiation services for export. The irradiated foods are mainly spices such as chili, turmeric, coriander, zinger, nut, spirulina, pet food, mushroom etc. Different medical items and pharmaceutical raw materials are irradiated e.g. syringe, surgical gauze, bandage, aluminum tube, specimen container, Eye drape, empty infusion set, petri dish, filter, family planning kits, eye ointment, mannitol, PEG-600, bacitracin Zn etc.

Sl. No.	Number of services given Organization	Nature of Sample / service	Total number/ Quantity of Sample	Income (BDT)
a)	04 companies (22 consignment)	Food Irradiation	115.455 Ton	32,21,386
c)	08 companies (07 consignment)	Pet Food	10.327 Ton	3,65,129
Total				35,86,515

INSTITUTE OF NUCLEAR MINERALS (INM), AERE

Objective

Institute of Nuclear Minerals is mainly engaged in nuclear mineral exploration program in the potential area of Bangladesh. INM is responsible to explore atomic minerals containing uranium, thorium and other associated valuable metals in different prospective zones of Bangladesh together with nuclear technology transfer to different national, international mining companies, Government organizations for mineral resource exploration and development. Besides INM is now working on geochemical and mineralogical characterization of radioactive rock and sediment, radon survey in potential radioactive anomalous zone of Bangladesh and geoenvironmental studies. In addition, this institute provided geophysical borehole logging services as per demands of different organizations/companies

1. R&D work(s)

1.1 Borehole Geophysical Logging at AERE Campus for Subsurface Lithology and Aquifer Investigation

M.Z. Kabir, M.G Rasul, F. Deeba, M. Rajib, M.S. Islam, M.M Zaman, N.T. Dina, S.C Das and T. Saha

Borehole geophysical logging was conducted at AERE campus for identifying lithologic boundary and groundwater aquifer delineation. This borehole was logged by conventional logging techniques for natural gamma, self-potential and resistivity. Individual bed boundaries were identified from Gamma, SP and Resistivity logs at the total depth of the hole 30.5m (100 ft). Having some oxidized clay and sand part within the few feet depth, the clay layer characterizes upto 7.62m (25 ft) with a small layer of silty clay layer at 7.6-11.28m (25-37 ft) depth. Following these two layers, a depth from 11.28-18.3m (37-60 ft) is identified as fine to very fine sand. This layer is also found at the bottom part of the drill hole within the depth of 22.87m (75 ft) to the end of the hole. Between these two layers, a 4.57m (15 ft) thick medium to fine sand layer is found at a depth of 18.3-22.87m (60-75 ft). This sand layer shows low to moderate gamma counts of upto 80 counts per second (cps). The gamma count with corresponding SP and SPR indicate a permeable water bearing layer

that could be attributed as the upper aquifer. SP log reflecting to the negative side at a depth of 18.3-22.86m (60-75 ft) and corresponding SPR log indicate permeable water bearing formation. The SP and SPR log suggest that the formation water is fresh. Clay layers are characterized by high gamma counts (120 cps and above) and corresponding SP and SPR values that indicates the presence of clay minerals like muscovite and biotite. Short normal resistivity (16") and long normal resistivity (64") in the aquifer layer indicate increasing value attributing to fresh water. If we consider Gamma, SP and Resistivity logs together, it could be concluded that upper aquifer is permeable sandy layer containing fresh water.

1.2 Analysis of Micro-fracture and Vein Characteristics in Crystalline Basement Rock at Maddhapara Granite Mine for the Feasibility of Geological Repository

M.Z. Kabir, F. Deeba and M.S. Islam

This study is the characterization of the crystalline basement rocks in terms of micro-fracture and vein analysis at north-western Bangladesh as a host rock for nuclear waste repository. The performance of the basement rock was measured from the point of petrography, microfracture and vein characteristics and fracture mineralogy. In this respect, this study presents an analytical method for evaluating the distribution of microfractures and micropores based on Scanning Electron Microscopy (SEM) analysis. Four types of micro-fractures are observed in mineral's surface and these micro-fractures/micro-veins are filled with calcite and silica that makes the fracture stronger to resist fluid flow. Based on petrography and XRD, the crystalline basement in Maddhapara is comprised of quartz, feldspar, Amphibole, biotite, and pyroxene as major mineral phases. Minerals susceptible to alteration are: a) Plagioclase b) Biotite c) Pyroxene and d) Amphibole. Degree of alteration is very poor.

1.3 Textural and Mineralogical Characteristics of Beach Sediments Along Parky and Gohira, West Coast of Chittagang, Bangladesh

F. Deeba, N.T. Dina, M.Z. Kabir, and M.G. Rasul

The study investigates textural and mineralogical characteristics of sediment at Parky and Gohira beaches along Chattogram coast of Bangladesh. Twenty Samples were taken from foreshore at selected locations to evaluate sediment grain size distribution. Grain characteristics such as graphic mean, sorting, kurtosis and skewness were estimated using GRADISTAT software. The cumulative frequency curve was obtained by plotting grain size (in phi scale) versus cumulative percent using the Probability curve. Grain characteristics such as graphic mean, sorting, kurtosis and skewness were estimated and results demonstrated that the maximum sediment samples were fine to very fine sand, moderately well sorted to well sorted. Sediments were identified as fine skewed to coarse skewed with platykurtic, mesokurtic and leptokurtic characters at all the two beaches. Linear Discriminant Function (LDF) analysis of the samples indicates a shallow marine environment origin and sediment carried by deltaic and Turbidity action. Average heavy mineral concentration at Parky and Gohira beach is 52.71% and 25.92% respectively.

1.4 Occurrence and Distribution of Heavy Minerals Assemblages in Recent Sediments of the Dharla and Dudhkumar Trans-boundary River, Northern Lalmonirhat and Kurigram District, Bangladesh

N.T. Dina, F. Deeba, M.G. Rasul, M.Z. Kabir, M. M. Rajib, Moniruzzaman, S.C. Das, and T. Saha

The studied Dharla and Dudhkumar trans-boundary rivers are tributary of the Brahmaputra river, enters Bangladesh through the northern Lalmonirhat and Kurigram District and carries huge suspended sediments. Twelve sample from Dharla River and nine sample from Dudhkumar river sediment (composite sample, 10 ft) was collected from the exposed recently deposited bar, where sediments experienced minimal depositional reworking. These samples were sieved by "(Restch ASTM type) Sieving machine" for 30 minutes using different mesh size and 250 μm , 125 μm and 63 μm + pan size fraction was taken for gravity separation using heavy liquid bromoform (CHBr_3). The most frequent grain size for Dharla and Dudhkumar River sample was the 250 μm to 125 μm fraction indicating moderately well sorted fine sand with higher silt component, which were deposited under moderate to low energy conditions. For all samples, the highest concentration of heavy mineral was in the fine (250 μm) size fraction ranging from ~5.61% (Sample DK-1) to ~28.39% (Sample DH-12). The average heavy mineral contents in the 125 μm and finest (63 μm + Pan) fraction was 6.81% and 11.30% respectively.

1.5 Granulometric and Depositional Process Characterization in Karnajhara and Chilakhali River of Sherpur District

N.T. Dina, F. Deebea, M.G. Rasul, M.Z. Kabir, M. M. Rajib, Moniruzzaman, S.C. Das, and T. Saha

A systematic investigations on granulometric properties of river sediment will provide information of their entrapment, transportation, and deposition. The grain size analysis from Karnajhara, Chilakhali, Bhogai and Malijhi River sediments of Sherpur District was carried out to investigate their depositional process. The graphic mean, standard deviation, skewness and kurtosis of Karnajhara and Chilakhali river sediment ranges from 1.18 ϕ to 2.74 ϕ , 0.67 ϕ to 1.40 ϕ , -0.58 ϕ to 0.24 ϕ and 0.69 ϕ to 5.23 ϕ respectively. Granulometric studies clearly established that, the sediments were dominantly of medium sized grain, moderately sorted and very positively skewed. The kurtosis suggested dominantly leptokurtic nature of sediments. The sediments were deposited under moderate to low energy conditions with dominant rolling processes. The observations are supported by the frequency curves and bivariate plots between various textural parameters, confirming the polymodal nature of sediments with dominant sand fraction. The bimodal and unimodal nature of the sediments was also present at certain locations.

1.6 Radioactive and Rare Earth Element (REEs) Exploration At Transported River Sediments in Sherpur District, Bangladesh

M. Rajib, M.G. Rasul, M.Z. Kabir, F. Deebea, M. Moniruzzaman, N.T. Dina, S.C. Das, T. Saha and M. J. Uddin

Radiometric exploration of the season 2023-24 was conducted at several transboundary rivers of Sherpur District, North-eastern Bangladesh during April 2024. Objective of the survey was to investigate radioactive minerals presence in the transported sediments in Karnojhara, Vogai, Chilakhali and Malijhi rivers. To find out the source of radioactivity and rare earth element containing minerals in the river-born sediments, the survey was conducted using portable gamma-ray spectrometer (Gamma Surveyer II), Geiger counter (BR-9C series radiation detector) and Individual Dose Rate Meter (FS2011). Uranium (U-238), thorium (Th-232) and potassium (K-40) was determined in-situ in as many as 26 sampling points in between latitude 25.16237 to 25.29257 and longitude 89.94167 to 90.22215, as measured by Garmin ETREX 22X GPS system. The measurement of U, Th and K showed the presence of very small quantity of those elements and corresponding dose rates. The values ranged as 1.09-14.26 ppm of U-238 (averaging 3.92 ppm), 4.83-62.35 ppm of Th-232 (averaging 16.80 ppm) and 0.22-1.49% of K-40 (averaging 0.56%). Such radioactivities pose corresponding dose rates of 26.37-248.34 nGy/hr as measured by Gamma Surveyer (averaging 70.53 nGy/hr). The values indicate no such accumulation of radioactive minerals except two locations which are accumulated at the discarded finer sand particles left out after collections of gravel materials. Samples were taken from each location to measure the grain size, mineralogical composition and elemental concentration using various laboratory techniques.

1.7 Physical Reassessment of Heavy Mineral Deposits at Cox's Bazar Coast

M.G. Rasul, M. Rajib, M.Z. Kabir, F. Deebea, M. Moniruzzaman, N.T. Dina, S.C. Das and T. Saha

As part of BAEC initiative to assess the present physical condition of economic mineral deposits at the Cox's Bazar coast where 15 out of 17 deposits are located, a team consisting of 17 geologists conducted a two-weeks long field survey. Objective was to recommend future programs aiming for their commercialization. The detailed activities were accomplished by digitizing old deposit maps using satellite images, traversing along and across the deposits, field inspection through visual observation, collecting aerial images by drone and analyzing them, accumulating land use data and collecting representative sand samples for laboratory analysis. The physical assessment survey indicated that the previously reported heavy mineral deposits at the Cox's Bazar coast have affected various natural and manmade changes after their discovery. Significant reduction in heavy mineral reserve is anticipated from the previous calculation of 1.76 million tons. However, approximately 38% areas of those deposits appear to be still recoverable which can be considered for future exploitation.

1.8 Quantification of Rare Earth Elements in Monazite Grains from Coastal Placers

M. Rajib and M.G. Rasul

The current report presents the characterization of radioactive materials and rare earth elements (REE) containing minerals in heavy minerals as found in the south-eastern coastal placer deposits of Bangladesh. Samples were collected from previously reported heavy mineral deposits of the Cox's Bazar coast, namely Teknaf, Shaplapur, Inani and Cox's Bazar. Analytical techniques like X-ray diffractometer (XRD) and scanning electron microscopy (SEM) were applied for identifying and quantifying the radioactive materials and REEs in the separated heavy minerals. Three species of monazites (Th, Ce and La types) were identified in the separated monazite rich fraction. Radioactivity distribution of approximately 100 km length (from Sabrang zero point to Diabetic point, Cox's Bazar) was presented based on the measurement of uranium, thorium and potassium using portable gamma-ray spectrometer and individual dose rate meter.

1.9 Seismic Waveform Analysis of Earthquake Occurrence in the Vicinity of Auxiliary Seismic Station AS-007 (BRDH)

M. Rajib, M.G. Rasul and M.H. Rahman¹

¹*Rooppur Nuclear Power Plant Project, BAEC*

Seismic data from the Auxiliary Seismic Station (AS007-BRDH) under CTBTO are continuously being monitored for natural earthquakes generating in and around Bangladesh. The seismometer data from IDC through V-sat communication were analyzed to observe earthquake during last few months. During 2023-24, there were several earthquakes with magnitudes greater than 3.0 on Richter scale which could be detected at BRDH. The sources of those earthquakes were within Bangladesh territory, such as Sylhet, Dhaka, Teknaf while several of those were in Myanmar and Nepal as well. These occurrences of earthquakes within the vicinity of Bangladesh territory can be clearly observed at BRDH which can be used to confirm similar data from other sources. Besides, continuous monitoring of these earthquake occurrences could be analyzed for various geological events. These data could be useful also to solve the presence of any subsurface tectonic structures in and around Bangladesh.

1.10 Subsurface Radioactivity Distribution Mapping at a Contaminated Site of AERE

M. Rajib, T. Saha, S.C. Das, N.T. Dina, M. Moniruzzaman, F. Deeba, M.Z. Kabir and M.G. Rasul

Radioactivity was measured and the distribution at surface to subsurface was mapped at a contaminated site near the TRIGA Mark II research reactor of the Atomic Energy Research Establishment. Objective was to quantify the total volume of contaminated soil which needs to be removed. Five (5) bore holes of 5-10 feet were conducted using hand auger and samples were collected at every foot. Cs-137 was measured to get the artificial radioactivity in the soil samples. The values were plotted on 3-D graphic diagram to get the subsurface distribution of the radioactive materials. Based on the mapping, the required volume of contaminated soils those need to be removed was estimated.

1.11 Application of Aquatic Macrophytes for Waste Water Treatment in a Constructed Wetland

M. Rajib, M.S. Hossain and M. Parveen

Department of Environmental Science and Disaster Management, Daffodil International University.

The study analyzed the efficiency of submerged macrophyte *Egeria densa* for waste water treatment by removing heavy metals. The results of the study show that *E. densa* can survive in wastewater contaminated with low to moderate levels of heavy metals. The heavy metal tolerance levels of *E. densa* were found to be as follows: Cr (0 - 0.25 mg/L), Cu (0 - 0.25 mg/L), Fe (0 - 2.5 mg/L), and Zn (0 - 0.10 mg/L). *E. densa* demonstrated the highest heavy metal removal efficiency in low heavy metal contaminated wastewater where the removal efficiencies for Cr, Cu, Fe, and Zn were 93.7%, 91.20%, 87.2%, and 100%, respectively were observed. *E. densa* was not very effective in treatment of highly heavy metal contaminated wastewater where the heavy metal removal efficiency for Cr, Cu, Fe, and Zn were 36%, 54%, 35.2%, and 75%, respectively. The study suggested that *E. densa* successfully eliminated a substantial proportion of total heavy metals from wastewater contaminated with low to moderate levels of heavy metals. Therefore, the study recommends *E. densa* as a potential candidate for the constructed wetland system.

1.12 Installation of a Borehole for Lithological Study, Water Level Monitoring and Formation Material Characterization at AERE

M. Rajib and M.G. Rasul

A 100-ft (33 meters) borehole was constructed at the institute premise for the purpose of the lithological study through physical observation of the collected samples and geophysical logging, ground water level monitoring as well as characterization of the subsurface formation materials such as clay and sands of various sizes. The borehole was designed as 4-inch diameter to fit for the logging probe which was conducted just after the construction. However, for keeping the borehole for future utilization, PVC pipe was installed for the entire borehole with 10-feet screens at two different depths. Samples were collected at every 1.5 meters where first nice samples were obtained as undisturbed core of maximum 10 inches. After 10 samples, the undisturbed samples were not possible to obtain due to loose sandy formation materials. Among the undisturbed samples, 8 were found to be Madhupur Clay characterized by very sticky in nature. The sandy materials of various sizes underneath the clays belong to Dupitila formation that continues upto the end of the borehole. The vertical distribution of natural radioactivity was also measured in the collected sample. The borehole was stored for future water level monitoring as well as can be used for demonstration activities for geophysical and nuclear logging.

1.13 Vertical Distribution of Natural Radioactivity at a Borehole Site at AERE, Bangladesh

T. Saha, M. Rajib, F. T. Shifat*, M. S. Rohani* and S. M. Sayem*

*Department of Geological Sciences, Jahangirnagar University

Natural radioactivity was measured using a portable Gamma-ray spectrometer at one foot interval depth of a 30m deep borehole at Atomic Energy Research Establishment (AERE). The borehole is characterized by high plastic sticky clay to silty clay upto 11m followed by fine sand upto 22m and silty sand upto the bottom of the hole (30m). The measured radiation of ²³⁸U, ²³²Th, and ⁴⁰K were in the range of 6.56-8.12 ppm, 16.58-20.67 ppm and 1.48-2.46%, with the average of 7.18 ppm, 18.63 ppm and 2.12%, respectively. The corresponding dose rates were 106.77-123.63 nGy/h with an average value of 114.9 nGy/h. The quantity of U and Th is of background level, however, the K values showed significantly high. Higher potassium values were found at upper part of borehole upto 10m depth. Subtle presence of clay in sand at lower depth also showed increased K value comparing to overlying fine sand. Combining these, it was observed that increased radioactivity is evident in the clayey formation which is mostly due to the presence of potassium, a natural characteristic of such type of sediment.

1.14 Study on Geomorphological Changes Using Satellite Image Analysis for Economic Mineral Prospecting at Kutubdia Island, Cox's Bazar.

T. Saha, M. Rajib and M. G. Rasul

Geomorphological changes were examined through satellite imagery and historical data to comprehend their impact on mineral distribution. This study utilized the Digital Shoreline Analysis System (DSAS) to illustrate the altered dynamics of Kutubdia Island. Shoreline positions from 1988, 2000, 2011, and 2024 were extracted, spanning a 36-year period. The analysis of shoreline changes reveals that erosion has been prevalent across the entire island over the last 36 years, with significant erosion observed in the southern and western parts, while minor accretion occurred in the northern and eastern segments. Placer sand samples from near-surface deposits were analyzed, and heavy liquid separation techniques showed that the average heavy mineral concentration in Kutubdia Island's raw sand samples is 49.73%. The study found that intense erosional activity corresponded with a significant decrease in heavy mineral concentration, whereas the accreted northern side had the highest heavy mineral concentration, reaching up to 93%. Additionally, this research assessed the effectiveness of medium-resolution satellite imagery in mapping shoreline positions and estimating historical rates of change.

1.15 Assessment of Heavy Metals Contamination in Invertebrates from the Cox's Bazar Coast, Bay of Bengal

T. Saha, R. N. Kakon*, B. A. Begum, Y. N. Jolly and S. K. Saha*

*Department of Geology, University of Dhaka

Heavy metals were analyzed in invertebrate samples along Cox's Bazar coastline and at St. Martin Island, the Southeast coast of Bangladesh. As primary consumers and ecological indicators, invertebrates play a vital role in the health of marine ecosystems. The X-ray fluorescence (XRF) technique was employed to analyze heavy metal concentrations in samples, revealing higher concentrations of Cr, Mn, Fe, Co, Zn, Cu, Hg, and Pb in invertebrate samples. Pollution index methods, including Contamination Factor (CF), Degree of Contamination (Cd), and Pollution Load Index (PLI), indicated moderate levels of contamination in invertebrates. Notably, invertebrate samples exhibited higher contamination levels than sediment samples. The findings underscore the substantial risk facing the marine ecology of Cox's Bazar coast due to metal concentration levels in invertebrates as such kind of pollution may extend its impact across the entire ecosystem. This research has found the escalating pace of environmental degradation, largely due to human activities, poses a significant threat to the coastal and marine ecosystem along the eastern coastline of Bangladesh.

1.16 An evaluation of Some Geotechnical Characteristics of the Madhupur Clay Soil from AERE, Ganakbari, Savar

S.C. Das, Md. Moniruzzaman, M.G. Rasul, M.Z. Kabir, F. Deebea, M. Rajib, N.T. Dina, T. Saha

The current study involves assessment of some geotechnical characteristics such as particle size distribution, moisture content and soil classification. For this purpose, 15 soil samples were collected from AERE campus, Ganakbari, Savar based on detail litholog of excavated subsurface up to a depth of 10m. The lithology shows dark grey to bluish grey alluvium soil at top and reddish to yellowish red sandy soil down downwards with the presence of ferruginous to calcareous nodules and mottled clay. The particle size distribution study indicates that the soils are mostly silty sand to sand with little clay. The moisture content study demonstrates that soils having a mean moisture content of 20.28%. The investigated soil classed as dominantly silty sand soil. The present study results coincide with the previous studies dealing with geotechnical qualities of Madhupur clay in other parts of Bangladesh. This study fulfils part of the broad target of assessing the suitability of Madhupur clay formation as a prospective host rock for disposal of radioactive wastes.

1.17 Elemental Composition of Madhupur Clay at AERE Campus

Md Moniruzzaman, S.C. Das, M.G. Rasul, M.Z. Kabir, F. Deebea, M. Rajib, N.T. Dina, T. Saha

The present study aims to estimate the mineralogical and elemental composition of Madhupur clay soil from AERE campus. Soil samples were collected from four boreholes each drilled at depth of 40 feet. Samples were collected at an interval of 6 feet from four different boreholes to cover the entire Madhupur clay formation based on the field observation and lithology. X-ray diffraction (XRD) and Scanning electron microscopy (SEM) techniques were employed to decipher the mineralogical composition and surface morphology (particle size, shape and texture) of minerals and elemental composition, respectively. XRD of Madhupur Clay indicates the dominant presence of quartz and feldspar along with clay minerals such as illite, illite-smectite, kaolinite and chlorite. SEM images also supplemented the presence of those minerals. The confirmation of composition and their geochemical evolution are being studied by further analysis of those XRD and SEM data.

2. Manpower Development(Training/Fellowship/Workshop/Meeting)

2.1 Attend in Training/Fellowship/Workshop/Meeting

Name	Title of the program	Date	Place
Dr. Mohammad Rajib	First Research Coordination Meeting (RCM) on "Development of radiometric methods to measure and study hydrodynamics of constructed wetlands (F22076)"	5 days, 6-10 November, 2023	IAEA Headquarters, Vienna International Centre, Vienna, Austria
S.C. Das	'Training Workshop on Fire safety'	2 days, 13-14 Sep, 2023	INST, AERE, Dhaka

S.C. Das	FTC on Reactor Engineering Course	12 days, 03-14 Dec, 2023	Training institute, AERE, Savar, Dhaka
Dr. Md. Moniruzzaman	First Research Coordination Meeting on the Climate Change Coordinated Research Project, EVT2303449	24 to 28 June 2024	IAEA Headquarters, Vienna International Centre, Vienna, Austria

3. Oral/Poster Presentation in Seminar/Symposium/Conference (National/International)

Name of the Participant	Title of oral/poster presentation	Title of the event	Organizer	Date	Place
Dr. Md. Moniruzzaman	Geospatial and hydro-geotechnical study for flood monitoring at NPP site in Bangladesh	First Research Coordination Meeting on the Climate Change Coordinated Research Project, J72007	IAEA	26 June 2024	Vienna, Austria

4. Collaboration work/MoU (ADP/FNCA/MEXT/FTC/IAEA/RCA/TC/S&T/CRP/In-house project/Universities, etc.)

4.1 Special Research Grant (S&T)

a) Title: Analysis of Micro-fracture and Vein Characteristics in Crystalline Basement Rock at Maddhapara Granite Mine for the Feasibility of Geological Repository

Duration: 1 (one) year.

Funding Source: Research Contract Proposal on Capacity Utilization Program under Special Allocation for Science and Technology for the Financial Year, 2023-24 financed by Ministry of Science and Technology (MoST), Bangladesh.

Objective: i) Characterizations of fractures and fracture networks in the form of exposure scale-study of the in-situ rocks within the mine
ii) Analysis of microfracture and vein texture in drill core sample as well as in the subsurface basement rock.

b) Title: Exploration for Radioactive and Rare Earth Element Containing Minerals in Geological Environment of Bangladesh.

Responsibility: Principal Investigator (PI)

Duration: 1 (one) year.

Funding Source: Research Contract Proposal on Capacity Utilization Program under Special Allocation for Science and Technology for the Financial Year, 2023-24 financed by Ministry of Science and Technology (MoST), Bangladesh.

Objective: To explore and analyze various radioactive and rare earth containing minerals from different geological environment of Bangladesh.

4.2 Special Research Grant (R&D)

a) Title: Study on Geomorphological Changes Using Drone and Satellite Image Analysis for Economic Mineral Prospecting at Kutubdia Island, Cox's Bazar.

Responsibility: Project Director (PD)

Duration: 1 (one) year.

Funding Source: Research and Development fund for the Financial Year, 2023-24 financed by Ministry of Science and Technology (MoST), Bangladesh.

Objective: To study of morphological changes and investigate the potential areas of economic mineral deposition and their distribution.

b) Title: Appraisal of Occurrence of Uranium in Crystalline Basement Rocks from North-West Bangladesh: an Integrated Radiometric and Geochemical Approach

Responsibility: Project Director (PD)

Duration: 1 (one) year.

Funding Source: Grant on Innovative Technology, Research & Development (R & D) project for Science and Technology for the Financial Year, 2023-24 financed by Ministry of Science and Technology (MoST), Bangladesh.

Objective: i) to measure the radioactivity concentration of NORMs (238U, 232Th and 40K) in the crystalline basement rocks from North-west Bangladesh and ii) to quantify the elemental concentration and assess the occurrence of uranium in crystalline basement rocks from North-west Bangladesh

4.3 Coordinated Research Proposal (CRP)

a) Title: Determination of Radionuclide Sorption Capacity of Constructed Wetland Materials for Hydrodynamics Study (CRP#26702) Under CRP Code F22076: Development of Radiometric Methods to Measure and Study Hydrodynamics of Constructed Wetlands.

Responsibility: Chief Scientific Investigator (CSI)

Funding Source: International Atomic Energy Agency (IAEA)

Duration: 4 (four) years

Objective: To study the adsorption coefficient of both geological and construction materials to assess the migration of radioactive tracer.

b) Title: Climate Change Challenges to the Safety of Nuclear Installations

Responsibility: Chief Scientific Investigator (CSI)

Funding Source: IAEA

Duration: November 2023 to October 2027

Objective:

1. Assessing and monitoring flood and draught impact at/off RNPP site employing geospatial technique
2. Investigating flood and draught effects in GW/surface water (availability, quality and sources) and river bank stability by hydro-geotechnical study
3. Establishing a flood and draught monitoring capacity at BAEC

4.3 Forum for Nuclear Cooperation in Asia (FNCA)

Title: **Radiocarbon-based approach to evaluating the CO₂ emission from forest soils in Asia**

Responsibility: FNCA Counterpart- Dr. Md. Golam Rasul

Duration: 04/2023 - 03/2029 (6 years)

Objectives: The overall objective of this project is to understand processes driving carbon cycling in terrestrial ecosystems (soils, in particular) and their sensitivity to rise in temperature, and to predict carbon cycle feedback to global warming.

5. Service Rendered

Sl. No.	Name of Service Provided	Number/Quantity of sample/patient/service	Revenue Income (if any)
01	Center for Geoservices and Research(CGR)	04	100000
02	Center for Geoservices and Research(CGR)	01	25000
03	M/S, MAN Enterprise	01	35000
Total 160000 Tk.			

6. Repair & Maintenance, Renovation works, etc.

i) Bangladesh holds an Auxiliary Seismic Station (AS007) at Bariadhala (BRDH), Chattogram under the Comprehensive Test-Ban Treaty Organization (CTBTO) to observe artificial earthquakes generating from nuclear tests. As designated National Data Center (NDC), Bangladesh Atomic Energy Commission carry out the operation, maintenance and calibration of the seismometer at AS007 with the continuous support from International Data Centre (IDC) at CTBTO head office at Vienna. The seismometer data from IDC through V-sat communication can be utilized for natural earthquake monitoring as well as subsurface geological information. To obtain those related data for civil and scientific application, AS-007 needs to be regularly calibrated. This calibration is also necessary for the International Data Centre (IDC) to effectively use the

captured data from AS-007. During 2023-24, the calibration of AS-007 were conducted on November 6, 2023 where all three channels (BHZ, BHN and BHE) were successfully tested. These activities were conducted by Dr. Md. Golam Rasul as Principal User and Dr. Mohammad Rajib as PKI Operator and Principal User.

ii) Demonstration of RAS 24 Shallow Seismograph (Siestronix) for shallow seismic survey in AERE campus: A day long test demonstration of RAS24 was conducted in AERE campus to check the machine voltage and data acquisition capability. Test results shows too low machine internal voltage/analog power, cannot be distributed through the ground geophones and thus, data acquisition was not successful. It was checked by a company, still unresolved but under observation.

INSTITUTE OF NUCLEAR MEDICAL PHYSICS INSTITUTE (INMP), AERE

Introduction

Globally, the number of cancer patients is rising at an alarming rate, and Bangladesh is not an exception. In reference to this context, the endeavor to create a specialized institute for cancer research was initiated in 2013 and reached its final form in 2018. Since then, the Institute of Nuclear Medical Physics has dedicated itself to offering both affordable conventional treatment options and state-of-the-art research on this sneaky illness. In addition, it is producing skilled nuclear medical physicists and technologists by providing appropriate academic and hands-on training.

At INMP, we currently offer radiation therapy for cancer using a top-notch LINAC equipment, as well as PET-CT and ultrasound technology for diagnosis. The united efforts of a scientist, engineer, and doctor at INMP have created a multidisciplinary research environment on several branches of a cancer treatment facility. Numerous research articles are published worldwide in journals with high impact factors each year. All year long, a number of research groups from several Bangladeshi universities collaborate on projects related to our service and research.

Objective

The prime objectives of this institute are -

- To provide patient's services for cancer detection and radiotherapy through medical physics techniques.
- To build up skilled radiation oncologists, medical physicists and technologists through academic and specialized training.
- To establish a Cyclotron facility for the production of isotopes, MRI and Brachytherapy facility in order to clinical use and multidisciplinary research.

INMP is dedicated to addressing the challenges posed by cancer through its holistic approach, encompassing patient care, research, and the development of advanced treatment facilities.

Activities

1. R&D work(s)

Scientific Routine Activities : Quality Control (QC)

	QC	Times	By using
LINAC	Absolute Dosimetry	07	Water phantom
	Relative Dosimetry	03	3D water phantom
PET CT	Air Calibration of CT	60	-
	Image Quality of CT	57	CAT phantom
	PET QC	172	²² Na source

2. Manpower Development

Arranged Training program /Workshop /Seminar /Symposium/Conference

Sl. No.	Title (Training program/Workshop/Seminar/Symposium/ Conference)	Date	Place	No. of Participant
a)	In-house Seminar : 1 hour x 2 lectures (2out of 12)	07/06/2023 to Continue	INMP, AERE	2 out of 12

3. Attended in Seminar/Symposium/Conference/Workshop/Meeting

Name of the Participant	Title of the event	Organizer	Date	Place
b) Md. Khairul Islam (SEO)	Nuclear and Radiological Emergency Preparedness Course	BAEC	10-21Sep. 2023	TI,AERE
Dr. M Rafiqul Islam	Workshop on Localization of Sustainable Development Goals (SDGs)	RPATC	25 th October 2023	RPATC, Dhaka
Dr. M Rafiqul Islam	RAS 6088: final regional coordination meeting of the non-agreement to project 'strengthening education and clinical training programmes for medical physicists'	IAEA	30 th October to 3 rd November 2023	Bangkok, Thailand
Dr. M Rafiqul Islam	Training Course on PPR-2008 management	BAEC	28 th Janu-8 th Feb 2024	TI,AERE
Dr. M Rafiqul Islam, Md. Abul Hasnat (SO), Rayhan Alam (SO),Dr. Fatema Tuz Zohra (MO),Md. Khairul Islam (SEO),	27 th National Conference of SNMB; 2024	SNMB	08 th March, 2024	Hotel Inter Continental, Dhaka
Jahid Hasan, Md. Moinul Hossen Robi	General Behavior and Office Rules	BAEC	05-07, March, 2024	TI,AERE
Rayhan Alam (SO)	Training Course on Radiation Protection for Radiation Workers and RCO's of BAEC Medical Facilities and Industries	BAEC	02-06 June 2024	TI, AERE

5. Service Rendered

Sl. No.	Name of Service Provided	Number/Quantity of sample/patient/service	Revenue Income (if any)
a	PET Scan	868	21712500/-
b	Ra	42	581840/-
c	USG	39	10,800/-
Total =			22305140/-

BEACH SAND MINERALS EXPLOITATION CENTRE (BSMEC), COX'S BAZAR**Objective**

- Geological exploration for economic placer minerals in the coastal and fluvial depositional environment of Bangladesh.
- Laboratory analyses and plant processing of placer sands; separation of economic minerals like magnetite, ilmenite, zircon, garnet, rutile, silica from bulk sand.
- Comparative study on the occurrence, distribution, mineral composition and characteristics of heavy and radioactive minerals from coastal and fluvial environment of Bangladesh.
- Determining radionuclides and trace elements in the sediments and seawater of southeast coast.
- Laboratory enrichment of radioactive mineral (i.e. Monazite) and quantification of radioactivity and REE content.
- Providing research support and industrial training to academic and professional organizations.

1. R&D work(s)**1.1 Assessment of Coastal Heavy Mineral Resources along the Cox's Bazar Coast**

M. M. Karim, M. F. Hossain and M. M. Islam

To assess the present physiographical condition of beach placer deposits, a team consisting of 16 geologists was formed to conduct a field survey (17th February- 1st March 2024) along the Cox's bazar coastline and offshore islands. Objective of the study was:

- The current physical condition of the existing heavy mineral deposits;
- Identification of new mineralization zones;
- Probable resource estimation of heavy minerals at the coastal belt of Bangladesh.

During field observation, the existing mineralization zones were thoroughly studied through digitization of old maps of heavy mineral deposits, visual observation, UAV imaging and collecting sand samples from representative locations using hand augers. Total 46 (forty six) raw sand samples were collected and analyzed for richness. It was observed that the mineralization zones are strongly affected by natural and anthropogenic activities. Satellite and drone images indicated that HM deposit at several zones is mostly washed out by active erosion due to natural calamities. Despite these reducing quantities of HM, many deposits were found to be still easily accessible and potentially extractable with few or temporary settlement and some parts of few deposits still remain without significant change where remnants of backdune deposits are observed. It was also inferred that the HM rich sand might have shifted to other parts of the coast as well as in the offshore areas by the shore current. In addition, recent backdunes and foredunes were found to be rich in heavy minerals which became stable over last couple of years. Lowering the cut-off grade for commercial exploitation could make these areas be considered as economic.

Therefore, a detailed feasibility study considering the present human settlement condition, extension and deeper depth drilling using advanced technologies is recommended for the re-estimation of the economic reserve for the commercial utilization of those beach minerals. Radioactivity content and Rare Earth Elements (REE) presence can be considered as value addition during the economic beneficiation of those minerals.

1.2 Analysis of the sedimentary environment and mineral resource of coastal Island (Monpuradwip, NijhumDwip, ShaporirDwip and Teknaf)

(A collaboration work with Department of Oceanography, Shahjalal University of Science and Technology)

M. M. Karim, M. F. Hossain

As a part of collaborative scientific research activity with Department of Oceanography, Shahjalal University of Science and Technology, 20 (twenty) samples were studied for heavy minerals concentration analysis. Sample was collected from Monpuradwip, NijhumDwip, ShaporirDwip and Teknaf. For present analysis, bromoform of Alfa Aesar, UK, with density of 2.81g/mL was used. Standard technique was adopted for the heavy mineral separation at sample and bromoform ratio of 1:3. Heavy and light fractions were collected and recorded for further analysis.

2. Manpower Development (Training /Fellowship/ Workshop/Meeting)

2.1 Attend in Training /Fellowship/ Workshop/Meeting

Sl. No	Title of the program	Date	Place	Number of participants
1	Training course on “Environmental Radioactivity Monitoring (ERM)”	29.10.2023-02.11.2023	TI, AERE, Savar.	1
2	“সুনীল অর্থনীতিতে বাংলাদেশ ও শানোগ্রাফিক রিসার্চ ইনস্টিটিউটের গবেষণাঃ বর্তমান ও ভবিষ্যৎ পরিকল্পনা” শীর্ষক সেমিনার	06.03.2024	NSTC, Dhaka	1
3	“অভিযোগ প্রতিকার ব্যবস্থা ও জিআরএস সফটওয়্যার” (Virtual with zoom)	30.04.2024	BAEC HQ	1

3. Oral /Poster Presentation in Seminar/Symposium/Conference

Name of the Participant	Title of oral/poster presentation	Title of the event	Organizer	Date	Place
Md. MasudKarim	Thorium (^{232}Th) Radioactivity in Beach Sand: Implications of Monazite Beneficiation via Radioactive Waste Processing at BSMEC, Cox’s Bazar.	International Conference on Oceanography (ICO-2024)	Bangladesh Oceanographic Research Institute (BORI)	27-28 January 2024	BORI Campus, Cox’s Bazar
Sheikh Jafrul	Ocean Thermal Energy				

Hassan	Conversion and Tidal Power as Possible Renewable Energy Sources in Bangladesh.				
Md. FahadHossain	Physical Assessment of Exposed Heavy Mineral Deposits at Shilkhali and Lomburi Area, Teknaf, Cox's Bazar.				
Md. MasudKarim	Management of NORM in Mineral Sand Processing: Conversion of Waste to Resource Approach at BSMEC, Cox's Bazar.	BCSIR Congress-2023	Bangladesh Council of Scientific and Industrial Research (BCSIR)	08-10 March 2024	BCSIR HQ, Dhaka
Md. MasudKarim	Decontaminating NORM via Monazite Beneficiation from Radioactive Waste of the Heavy Minerlas Separation Plant at BSMEC, Cox's Bazar.	2nd National Seminar on "Geology for the Sustainable Development of Bangladesh"	Geological Survey of Bangladesh (GSB)	09-10 May 2024	Petro Centre, Petro Bangla, Dhaka

ATOMIC ENERGY CENTRE (AEC), CHATTOGRAM

Objectives:

- Ensure safety of food and environment from radioactive contamination;
- Monitoring and assessing of pollution level in marine and coastal environment due to nuclear activities or radioactive waste disposal;
- Promote research and development activities on environmental issues;
- Expand cooperation with other scientific organizations, universities, private and public sectors through mutual exchange of educational programs, training, technical cooperation and expert services;
- Develop human resources in the field of nuclear science and technology.

1. R & D work(s)

1.1 Assessment of Natural Radioactivity Concentration in Surface Soil of Sylhet Division by Measuring Activity Concentration of Natural Radionuclides and Radiological Hazard

AKM S. I. Bhuiyan, M. Debnath, N. S. ResmaR. Roy and S. Hossain

This study aims to assess natural radioactivity in the surface soil of four district of Sylhet division namely Habiganj, Moulvibazar, Sunamganj and Sylhet by measuring concentrations of radionuclides (U-238, Th-232, and K-40) and evaluating associated radiological hazards. Surface soil samples (0–5 cm depth) have been collected from 30 locations from each district covering urban, rural, and forest areas to ensure a comprehensive assessment. Samples will be air-dried, homogenized, and sieved. U-238, Th-232, and K-40 activity concentrations will be measured using High-purity Germanium (HPGe) detectors in a gamma spectrometry lab. Quality assurance will be maintained through duplicate samples and reference materials. Parameters such as absorbed dose rate, annual effective dose, radium equivalent activity, and external hazard index will be calculated. Results will be compared with international safety standards. Different statistical analysis and GIS mapping will be used to interpret data and visualize spatial distribution patterns. This study will provide insights into natural radionuclide concentrations in Sylhet's soil, estimate potential radiological hazards, and produce spatial maps of radioactivity distribution. The findings will contribute to public health, environmental management, and local policy-making by offering data on natural radiation exposure risks.

1.2 Assessment of Natural Radioactivity and Radiological Health Hazard on Inhabitants of Chattogram Division by Measuring Radio Activity Concentration of Natural Radionuclides

AKM S. I. Bhuian, M. Debnath, N. S. Resma, R. Roy and S. Hossain

Abstract: This study aims to investigate the levels of natural radioactivity in surface soils across the Chattogram division, Bangladesh, by measuring the concentrations of radionuclides (U-238, Th-232, and K-40) and assessing the related radiological risks. Soil samples, taken from 0–5 cm depths at 40 locations from Chattogram, Cox’s Bazar, and Rangamati districts, will cover diverse environments such as urban, rural, and hilly areas to ensure a well-rounded analysis. Rest districts (Bandarban, Khagrachhari, Feni, Lakshmipur, Comilla, Noakhali, Brahmanbaria, and Chandpur) will be considered for background assessment of natural radioactivity concentration. The collected samples will undergo air-drying, homogenization, and sieving before their radionuclide activity is analyzed using High-purity Germanium (HPGe) detectors in a gamma spectrometry lab. Quality control will be maintained through duplicate samples and certified reference materials. Key radiological indicators, including the absorbed dose rate, annual effective dose, radium equivalent activity, and the external hazard index, will be

and compared against international benchmarks for safety. Additionally, statistical techniques and GIS-based spatial mapping will be applied to visualize and interpret the distribution of radioactivity. The outcomes of this study could serve as important baseline radiological data for future research studies and environmental monitoring.

1.3 Measurements of Heavy Metal Concentrations and Associated Health Risks in Soils of Cumilla District by Systematic Gridding Method

Dr. AKM Saiful Islam Bhuian, Rashmi Roy and S. Hossain

Abstract: Heavy metal concentrations in soil pose a significant health risk due to their fluctuating nature due to natural and man-made activities. However, few places have been studied for their heavy metal concentrations, with most remaining unmeasured. To address this, a systematic gridding method was used to collect samples from the Cumilla district. The study collected soil samples from Cumilla district using a systematic gridding method to investigate the concentration of heavy metals, including lead, cadmium, copper, zinc, nickel, and chromium. The results showed significant variations in heavy metal concentrations, with Ni and Cu having the highest concentrations and Cd having the lowest, almost below the detection limit.

The study found that the soil in Nagari Para, Cumilla is contaminated with heavy metals, with mean concentrations of Ni and Cu being 1.359 mg/Kg and 0.800 mg/kg, respectively. The maximum concentration of Ni was 3.081 mg/kg, exceeding the safe limit set by regulatory agencies. The highest concentrations were found in CoSs-5, suggesting that sewage sludge used as fertilizer can contain high levels of nickel, leading to soil contamination and air pollution. The concentration of heavy metals in Cumilla district is lower than in other divisional districts, particularly Dhaka, and most other countries worldwide. The study area in Cumilla showed no cadmium contamination, but some contaminations were detected. The highest concentrations were Cr (1.468 mg/Kg), Ni (3.881 mg/Kg), Cu (1.473 mg/Kg), Zn (0.087 mg/Kg), Pb (1.03 mg/Kg), and Cd (-0.05 mg/Kg). These findings suggest the need for effective measures to control heavy metal pollution and protect soil quality in the area.

1.4 Monitoring of the Marine Environment for Enhanced Understanding of the Abundance and Impact of Marine Plastic Pollution in Bay of Bengal under RAS-7038 Project

N. S. Resma, R. Roy, N. Khatun and S. Hossain

IAEA has developed NUTEC Plastics to assist IAEA Member States in integrating nuclear techniques in their efforts to address challenges of plastic pollution. The project RAS7038, under the NUTEC umbrella, addresses marine micro plastic pollution. The project aims at improving plastic management in Asia and the Pacific Region through establishment of downstream baseline surveys along with status and trends of marine plastic pollution impacts. It also strengthens and scale-up the development of reliable and cost-effective techniques to assess the spatial and temporal abundance and character of marine plastics in order to better understand their origin, transport mechanisms, fate and impacts. This includes the establishment of harmonized, standardized protocols to identify microplastics in environmental samples, and establishment of analytical techniques that are in line with best practices and state-of-the-art science. Under this project, total 17 beach sand samples (with 5 replica) from Cox’s Bazar and Sonadia Island and 6 sea water samples (with 2

replica) from Bay of Bengal have been collected so far following IAEA protocol for microplastic sample collection. Till now, 4 beach sand samples of Cox's Bazar and 2 sea water samples from Bay of Bengal have been processed following recently developed IAEA sample preparation protocol.

Physical identification and quantification of the possible microplastic in the processed samples have been done using stereo microscope. Polymer characterization of the identified possible microplastic will have been done by Fourier Transform Infrared Spectrophotometry.

1.5 RFID-Based Identification and Tracking System for Safeguarding Radioactive Sources at RTML Laboratory of AECC

M. Debnath, R. Roy and S. Hossain

The proposed RFID-based identification and tracking system for safeguarding radioactive sources at RTML Laboratory of AECC aims to improve safety, efficiency, and compliance in managing these hazardous materials to facilitate the ease of use of these materials in routine activity of RTML. Current tracking methods are vulnerable to human error and lack real-time monitoring. It poses risks in terms of unauthorized access or accidental exposure. Implementing RFID technology will enable automated, real-time tracking of radioactive sources, enhancing both security and accountability. The system will involve attaching RFID tags to each source, with RFID readers installed at key locations in the lab. These readers will capture and transmit data to a central database, allowing lab personnel to monitor the movement and status of radioactive sources and receive alerts in case of anomalies. This solution is highly relevant to the lab's operational needs, providing a fail-safe mechanism to prevent the misplacement or theft of dangerous materials. To date, significant progress has been made: the literature review has been completed, the circuit schematics has been developed using Proteus software, and a comprehensive list of necessary instruments and materials has been prepared. The project is now at the stage of seeking funding for equipment procurement, after which the prototyping and testing phases will begin. Once implemented, this system will offer a critical enhancement to safety and efficiency at RTML.

2. Manpower Development(Training /Fellowship/Workshop/Meeting)

2.1 Attended in Training /Fellowship/Workshop/Meeting

Sl. No.	Title of the program	Date	Place	Name of Participants
01	First Research Coordination Meeting on Facilitation of Safe and Secure Trade Using Nuclear Detection Technologies (under CRP J2015)	29/10/23 - 04/11/23	Vienna, Austria	Dr. Shahadat Hossain, Director.
02	‘সুনীল অর্থনীতিতে বাংলাদেশ ওমানোগ্রাফিক রিসার্চ ইনস্টিটিউট এর গবেষণা বর্তমান ও ভবিষ্যৎ পরিকল্পনা’ শীর্ষক সেমিনার	06/03/24- 07/03/24	Cox'sbazar	Dr. Shahadat Hossain, Director.
03	The Sensitization workshop on Bangladesh National Single Windows System	22/04/24- 23/04/24	Brac Centre Inn, Dhaka.	Dr. Shahadat Hossain, Director. Dr. AKM Saiful Islam Bhuian, PSO.
04	Mid-Coordination meeting on Monitoring the Marine Environment for Enhanced Understanding of the Abundance and impact of Marine Plastic Pollutions (under RAS7038)	14/05/24 - 17/05/24	Vienna, Austria	Dr. Shahadat Hossain, Director.
05	Third Technical Meeting on Radiation Detection Instrument for Nuclear Security: Trends, Challenges and Opportunities.	14/08/23 - 18/08/23	Vienna, Austria	Dr. AKM Saiful Islam Bhuian, PSO
06	International Conference on Nuclear Security (ICONS)	20/05/24- 24/05/24	Vienna, Austria	Dr. AKM Saiful Islam Bhuian, PSO
07	International Conference on “Physics for Sustainable Development and Technology”	07/09/23 - 08/09/23	CUET	Dr. Sopan Das, SSO
08	International Conference on “Physics for Sustainable Development and Technology”	07/09/23 - 08/09/23	CUET	Dr. Sopan Das, SSO

09	International Conference on The Role of Science and Technology towards 4IR	5/10/23-6/10/23	University of Rajshahi, Bangladesh.	Nazma Khatun, SSO
10	Advanced Regional Training Course on Microplastic Analysis in Marine Samples (under RAS7038)	10/06/24 – 21/06/24	Monaco	Manish Debnath, SO.
11	Regional Training Course on Strategies and Design of Microplastic Monitoring Program (under RAS7038)	04/02/24 - 15/02/24	Safat, Kuwait.	Nighat Sultana Resma, SO.
12	Environmental Radioactivity Monitoring, FTC.	29/10/23 - 02/11/23	TI, AERE	Nighat Sultana Resma, SO. Rashmi Roy, Engr.
13	PPR-2008 and Public Procurement Management System-2024	28/01/24 – 08/02/24	TI, AERE	Rashmi Roy, Engr. Ferdous Begum, AO.
14	Workshop on Public Procurement (e-GP)	21/11/23	RPATC, Chattogram	Rashmi Roy, Engr.
15	অভিযোগ প্রতিকার ব্যবস্থা ও জিআরএস সফটওয়্যার	13/05/24	Online, BAEC	Nur Alam, Librarian

3. Organize Training /Fellowship/Workshop/Meeting

Sl. No.	Title of the program	Date	Place	No. of Participants
01	Literacy Principles and Fundamental Concepts of Ocean Health Strengthening for Sustainable Development.	02/05/24	AECC	200
02	Training on Custom Automation and ASYCUDA world system	02/04/24	AECC	18
03	PPR-2008 and Public Procurement Management-2024	20/02/2024	AECC	28
04	প্রাতিষ্ঠানিক দক্ষতা ও নৈতিকতার উন্নয়নে শুল্কাচার	21/03/24	AECC	26
05	সেবা বস্তু ও সু-শাসন প্রতিষ্ঠা (সহজ ও জবাবদিহি শক্তিশালীকরণ)	21/03/24	AECC	26
06	সেবা প্রদান প্রতিশ্রুতি: গুরুত্ব ও তাৎপর্য শীর্ষক আলোচনা সভা	14/09/23	AECC	20
07	জাতীয় শুল্কাচার কৌশল সম্পর্কে সাধারণ ধারণা প্রদান বিষয়ক প্রশিক্ষণ	10/09/23	AECC	20
08	পশকে চট্টগ্রামের জাতীয় শুল্কাচার কৌশল কর্মপরিকল্পনা বাস্তবায়ন সম্পর্কিত প্রশিক্ষণ	10/09/23	AECC	20
09	In house training on ISO Accreditation	20/07/23-26/07/23	AECC	20

4. Oral/Poster Presentation in Seminar/Symposium/Conference/Workshop (National/International)

Name of the Participant	Title of Oral/Poster Presentation	Title of the event	Organizer	Date	Place
Dr. AKM Saiful Islam Bhuian	Use of RPMs Alarm Assessment Process to Ensure Safe and Secure Trade: Experiences of Chittagong Sea Port, Bangladesh	Third Technical Meeting on Radiation Detection Instrument for Nuclear Security: Trends, Challenges and Opportunities.	IAEA, ICONS2024	14/08/23 - 18/08/23	Vienna, Austria
Nazma Khatun	Synthesis and Bioactivity Studies of Phenylthiazole Derivatives	International Conference on The Role of Science and Technology towards 4IR	Faculty of Science	5/10/23-6/10/23	University of Rajshahi, Bangladesh.
Rashmi Roy	Financial Feasibility and Environmental Sustainability of Rooftop Solar PV in Chattogram: A Case Study on Residential, Commercial, and Industrial Buildings.	International Conference on Advances in Computing, Communication, Electrical, and Smart Systems (iACCESS).	IEEE & ULAB	08/03/24-09/03/24	ULAB, Dhaka
Rashmi Roy	Evaluating Solar Energy as a Viable Solution to	7 th International Conference on	CUET	16/11/23-18/11/23	CUET

	Bangladesh's Energy and Environmental Challenges: Opportunities, Constraints, and the Path Forward.	Mechanical Engineering and Renewable Energy 2023 (ICMERE2023)			

5. Stakeholder Meeting

Sl. No.	Title of the program	Date	Place	No. of Participants
01	Stake Holder meeting with Bangladesh Trade Facilitation (BTF)	06/12/23	AECC	15
02	কর্মপরিকল্পনা ২০২৩-২০২৪ বাস্তবায়নের লক্ষ্যে সেবাপ্রদান প্রতিশ্রুতি বিষয়ক স্টেকহোল্ডারদের সভা	17/08/23	AECC	13

6. Collaboration work/MoU (ADP/FNCA/MEXT/FTC/IAEA/RCA/TC/S&T/CRP/In-house project/Universities, etc.)

- Program Title: Evaluation and Improvement of Efficiency of the RPMs Alarm Assessment Process to Ensure Safe and Secure Trade through Chittagong Sea Port, Bangladesh.
Program Type: IAEA-CRP (J2015)
- Program Title: Monitoring of the Marine Environment for enhanced understanding of the abundance and impact of Marine Micro-Plastic Pollution in the Bay of Bengal.
Program Type: IAEA-Non RCA (RAS7038)
- Program Title: Strengthening Ocean Health for Sustainable Development: A Global Approach Using Nuclear and Isotopic Techniques
Program Type: IAEA-Inter Regional Project (INT7022)

7. Service Rendered

Sl No.	Name of the service provided	Number/quantity of sample/ patient/service	Revenue income
1	Radioactivity testing of imported foods, allied materials & survey of miscellaneous materials	July	1208
		August	1158
		September	1298
		October	1825
		November	1615
		December	1201
		January	1399
		February	1297
		March	1828
		April	1789
		May	1285
		June	1178
		Total	17,081
			31,97,16999.00

RADIOACTIVITY TESTING AND MONITORING LABORATORY (RTML), MONGLA

Objective

Radioactivity testing of foods and other allied materials imported & exported through Mongla sea-port at Mongla, Bagerhat, Bhomra land-port in Satkhira, Benapole land-port and Jashore airport.

- Radioactive materials safety service to the port authority and customs department while inspection of special consignments that contain suspected radioactive materials in it. Activities like nuclear security, safeguard and controlling illegal traffic of radioactive materials in the region.

- Radioactivity analysis of environmental samples, harmful contaminated objects, radioactive material or any other sample requested for nuclear forensic investigation.
- Radiation protection and safety service during transport of radioactive materials imported or exported through Mongla port to assure safe handling of radioactive materials to and from the region.
- Radiation protection and safety service to the public, hospitals, local industries, universities or research institutes and exploration companies etc.
- Combine work in emergency service during nuclear and radiological incidents, accident in the region or in nationwide under joint operation by BAEC.
- Cooperation to implement the “Bangladesh Atomic Energy Regulatory Authority Act 2012” and “Nuclear Safety and Radiation Control Rule 1997”: Law number 19, 2012.

1. Attended in Seminar/Symposium/Conference/Workshop/Meeting

Name of the Participant	Title of the event	Organizer	Date	Place
1. Dr. Mst. Shafaly Khatun 2. Mithun Chandra Bhakto	Zoom meeting on “সুশাসন প্রতিষ্ঠার নিমিত্তে অংশীজনের অংশগ্রহণ সভা।”	SID, BAEC	06.11.2023	Headquarters, BAEC
1. Dr. Mst. Shafaly Khatun 2. Mithun Chandra Bhakto	Zoom meeting on “সেবা প্রদান প্রতিশ্রুতি বিষয়ে ২য় ত্রৈমাসিক সভা আহবান।”	SID, BAEC	31.12.2023	Headquarters, BAEC

2. Paper Presented in Seminar/Symposium/Conference/Workshop (National/International)

a) Natural and Artificial Radioactivity Level in Sediment of the Pasur River (Poster Presentation) in National Conference on Physics-2023.

3. Service Rendered

Sl. No.	Name of Service Provided	Number/Quantity of sample/patient/service	Revenue Income (if any)
a	Sample Analysis (Imported & exported food sample)	36	6,96,804/-
Total			6,96,804/-

II. BIO-SCIENCES

INSTITUTE OF FOOD AND RADIATION BIOLOGY (IFRB), AERE, SAVAR

Agrochemical and Environmental Research Unit, IFRB

Objective

Agrochemical and Environmental Research Division (AERD) is involved in research relating to analysis of elemental and pesticide residues and their impact on the environment and human health. The laboratory provides facilities to different Universities, Government and Non-government organizations for a long time by analyzing the presence of heavy metals, trace elements and pesticides residues in food and environmental samples.

The objectives are:

- To know the present status of residues of pesticides, heavy metals and trace elements in food and environment.
- To generate and provide pesticide residue data for fixing National Acceptable Daily Intake (ADI) and Maximum Residue Limit (MRL) of Bangladesh.
- To promote safe and effective use of pesticides for safe guarding human health and environment.

1. R&D work(s)

1.1 Health Risk Assessment of Heavy Metals in Fish Species and Sediments in Tanguar Haor at Sunamganj District

Z.Fardous, M.Nesha, M.A.Rahman and M.A.Z.Chowdhury

The presence of trace metals in aquatic ecosystems can have detrimental effects on fish survival. The Tangar haor, a Ramsar conservation wetland, receives sediment and water from multiple transboundary rivers. However, there have been limited studies on the metal concentrations in fish species in this sediment-rich wetland. This study aimed to analyze the concentrations of iron (Fe), manganese (Mn), chromium (Cr), copper (Cu), zinc (Zn), cadmium (Cd), and lead (Pb) in water, sediment, and fish tissues. Higher concentrations of Cd and Pb were found in the water and sediment. All these metals were detected in eight fish species, including benthic and pelagic species. Among them, *Systomus sarana*, a pelagic fish that also consumes benthic organisms, exhibited a higher metal pollution index than other fish, particularly benthic species. The release of higher metal concentrations from sediment into the water has the potential to impact the accumulation of metals in fish. Synopsis: This study on metal concentrations in fish species will aid policymaking on ecotoxicology research for transboundary river-connected wetlands.

1.2 Investigation of Heavy Metal Pollution in Soil and Water from the Tannery Region of Hemayetpur, Savar, Dhaka

M.Nesha, Z.Fardous, M.A.Rahman and M.A.Z.Chowdhury

The presence of heavy metals in soil and water has potential to pose a significant environmental damage and health risk to humans. The study examines heavy metal pollution in the soil and water from the tannery region of Hemayetpur, Savar. It mainly focuses on six metals: Fe, Pb, Cu, Zn, Cd, and Cr. The order of the metals found in the water was Fe > Pb > Cr > Zn > Cu > Cd, and all of the amounts were below the acceptable limit. Iron levels found in soil (ranging from 13,512.97 to 70,248.90 ppm) were much higher than WHO guidelines, and the order of contamination in the soil was: Fe > Cr > Zn > Pb > Cu > Cd. The Single Pollution Index (PI) showed that site SS-18 had a lot of Cr pollution (PI = 5.04) and sites L-3, L-4, L-9, and L-15 had a lot of Pb and Cu pollution. Besides, the Geo-Accumulation Index (Igeo) also demonstrated that some places had mild to heavy Cr and Fe pollution. Different levels of pollution due to combined metal loading observed by the Pollution Load Index (PLI) and the Nemerow Pollution Load Index (PINemerow). Site L-9 had the highest PLI score of 1.50, and most sites were slightly polluted, except for site L-18, which was moderately polluted. Overall, this study found a considerable level of heavy metal contamination in the study area during rainy season which indicate the deterioration of river ecosystem gradually. Therefore, continued research and monitoring is essential.

2. Manpower Development (Training/Fellowship/Workshop/Meeting)

2.1 Attended in Training/Fellowship/Workshop/Meeting

Sl. No.	Title of the program	Date	Place	Number of Participant
1.	EVT2206610 Bangladesh National Training Course on Nuclear Security Recommendations on Physical Protection of Nuclear Material and Nuclear Facilities,	18-22 September 2023	Obninsk, Russian Federation.	16
2.	In house training course on job code of conduct and discipline	05-07 March 2024	Training Institute, Atomic Energy Research Establishment, Savar, Dhaka.	42

3. Oral/Poster Presentation in Seminar/Symposium/ Conference(National and International)

Name of the Participant	Title of oral/poster presentation	Title of the event	Organizer	Date	Place

Dr. Muhammed Alamgir Zaman Chowdhury	Heavy metals in water, soil, vegetables and fish at the tobacco industrial sites in Rangpur city, Bangladesh: A health risk study	BCSIR Congress-2023 Theme: Smart Bangladesh of Tomorrow is the Science of Today	Bangladesh Council of Scientific and Industrial Research (BCSIR)	10 March 2024	Institute of Technology Transfer and Innovation (ITTI), BCSIR

4. Stakeholder Meeting

Sl. No.	Title of the program	Date	Place	Number of Participant
1.	The National Codex Committee (NCC) for the period of 2022-2024. (4th meeting)	10 October, 2023	Bangladesh Standard and Testing Monitoring Institute (BSTI), Dhaka-1208	25
2.	The National Codex Committee (NCC) for the period of 2022-2024. (5th meeting)	20 November, 2023	Bangladesh Standard and Testing Monitoring Institute (BSTI), Dhaka-1208	26
3.	The National Codex Committee (NCC) for the period of 2022-2024. (6th meeting)	17 December, 2023	Bangladesh Standard and Testing Monitoring Institute (BSTI), Dhaka-1208	26
4.	The National Codex Committee (NCC) for the period of 2022-2024. (7th meeting)	19 March, 2024	Bangladesh Standard and Testing Monitoring Institute (BSTI), Dhaka-1208	24

Food Safety and Quality Analysis Division, IFRB

Objective

Food Safety and Quality Analysis Division (FSQAD) is involved in carrying out research on food quality and safety, hazard identification, risk assessment, food processing, preservation and development of convenience food. The division also emphasizes on food authentication through molecular and other analytical techniques. The main objectives of FSQAD are focused on food irradiation processing, reducing post-harvest losses, combating food fraud, detection of hazardous factors (adulterants and contaminants), and exploring nutritional and functional quality through nuclear and complementary techniques to enhance food safety and security for consumers improving public health.

1. R&D work(s)

1.1 Impact of Gamma Radiation, Potassium Sorbate and Low Temperature on Shrimp (*Penaeus monodon*) Preservation

M. S. Islam, A. Hossain, M. Islam, M. K. Munshi, M. S. Hussain, K. C. Das, I. Ahmed, M. S. I. Khan, R. Huque

The objective this study was to assess the effect of gamma radiation and 2% potassium sorbate with low temperature (4 °C) for shrimp (*Penaeus monodon*) preservation. Fresh samples were prepared for treatment with gamma radiation at 1.0 and 1.5 kGy doses and potassium sorbate (2%) soaked for 30 s (PS 30 s) and 60 s (PS 60 s). Organoleptic score (OS), biochemical composition and microbiological analysis were performed to evaluate the shelf-life extension and quality changes during the storage periods. Data showed that combination treatment of gamma irradiation at 1.5 kGy with low temperature was the most effective in extending shelf-life of shrimp. The isolated bacteria associated with shrimp samples were identified through PCR technique. Antibiotic sensitivity test was examined using ten commonly used antibiotics against these pathogenic isolates. Gentamicin and Imipenem showed up to 50% resistance on Gram-positive (*Bacillus cereus* and *Staphylococcus aureus*). This study indicates that gamma irradiation treatment with low

temperature was most effective way for shelf-life extension of shrimp which might reduce the wastage of this important nutritional source.

1.2 Development of UHPLC-PDA Method for Determination of Caffeine in Raw and Commercial Tea

M. Shahjalal, M. A. Rahman, A. Hossain, M. Islam, M. A. Khatun, M. S. Hussain, M. K. Munshi, and R. Huque

Caffeine was extracted by the simple method of boiling water extraction and analyzed by UHPLC-PDA. The influence of main parameters affecting the method efficiency investigated and optimized. Under the optimal conditions, the method was successfully applied to determination of caffeine in different samples. The highest Caffeine (118.29 mg/L) is found in raw tea collected from one of the gardens. The lowest Caffeine (12.01 mg/L) is found in Chinese Slimming Tea. There is no caffeine found in Korean Red Ginseng Tea. The limit of detection (LOD) and limit of quantification (LOQ) were 0.01 and 0.03, respectively. Linearity range was 10ppm to 70 ppm and determination coefficient (r^2) was 0.9995.

1.3 Isotopic Characteristics ($\delta^{13}\text{C}$, $\delta^{15}\text{N}$, and $\delta^{18}\text{O}$) of Honey from Bangladesh Retail Markets: Investigating Sugar Manipulation, Botanical and Geographical Authentication

M. A. Khatun, J. Yoshimura, M. Yoshida, Y. Suzuki, R. Huque, S. D. Kelly, and M. K. Munshi

The study analyzed stable isotope composition (carbon, nitrogen, oxygen) of Bangladesh origin monofloral and multifloral honey for the first time to identify the C-4 plant sugar adulteration, botanical and geographical differentiation. The C-4 sugar content (11.90 to 86.61%) using carbon isotope values of whole honey and protein extract identified 18% adulterated honeys. Whereas 82% honey have been detected as authentic with the $\delta^{13}\text{C}$ ranges from -24.86 to -29.26‰ and the C-4 sugar values ranges from -6.75 to 5.67%. The chemometric approach using carbon and nitrogen isotopes values revealed discrimination among floral types of Bangladeshi authentic honeys indicating the influence of botanical source on isotopic composition. Canonical discriminant analysis (CDA) of C and N isotopes showed geographic distinction among Bangladeshi and overseas origin honeys. It is notable that the black seed honeys were correctly classified with the CDA analysis representing this type as unique Bangladesh brand as New Zealand manuka honey.

1.4 Microbial Quality of Vegetable Salad Items Sold in Street Vended Restaurants in Uttara Region

A. Hossain, M. S. Hussain, M. A. Rahman, M. Shahjalal, M. Islam, M. A. Khatun, and M. K. Munshi

The aim of this study was to determine raw mixed vegetable salads served in different street vended Restaurants in Uttara Region of Dhaka city. In this study a total of 5 samples were analyzed for detection and enumeration pathogens such as *Staphylococcus aureus*, *Escherichia coli* and *Salmonella-Shigella* according to standard microbiology methods. From all tested samples, the average values of *S. aureus*, *E. coli* and *Salmonella-Shigella* count was found to be 5.91 $\log_{10}$ (CFU/g), 5.72 $\log_{10}$ (CFU/g) and 5.62 $\log_{10}$ (CFU/g), respectively. This unsatisfactory presence of food borne pathogens showed a failure of the sanitary quality vegetables salads that were uncovered and unprotected, exposed to the air and at ambient temperature for sale. In conclusion, high microbial presence, serve as an indicator of the need to raise awareness about the potential health hazards caused by improper handling of these vegetables.

1.5 Potential Usage of Gamma Radiation on Sensory Evaluation, Biochemical Properties Along With Heavy Metals Analysis of Dietary Fiber Obtained From Pineapple Peel

M. S. Mia, M. Islam, R. Huque, M. K. Ahamed, M. Nahar, M. A. Khan, M. M. Islam, A. K. M. R. K. Zoardar, and M.E. Molla

Agro-industries play a significant role for nutrition intake; however, they produce a considerable quantity of fruits and vegetables wastes or byproducts during processing that are mostly unused. Production of value-added products from the generated wastes could be a possible tool for the waste management in this sector. The present work was aimed at production of value-added dietary fiber from pineapple peel and investigates the potential effects of gamma irradiation at different doses (5, 10, 20, 30 and 40 kGy) on this dietary fiber in respect with sensory evaluation, biochemical properties and heavy metal analysis. There was no significant effect of radiation found on appearance, color, flavor, taste and texture in the dietary fiber. Significant

reduction in lipid content was seen in fiber irradiated with 30 kGy dose compared to untreated fiber. Besides, irradiation has no significant effect on moisture, ash content and calcium of dietary fiber. Irradiated dietary fiber showed decreased total phenol content than the unirradiated sample. Irradiation with 30 and 40 kGy doses increased protein content compared to control dietary fiber. PIXE analysis showed there was no Lead and Cadmium heavy metal in pineapple peel dietary fiber.

1.6 Role of *Bacillus cereus* Biofilm Formation Behavior in Virulence and Pathogenic Characteristics

E. J. Park, M. S. Hussain, F. Elahi, A. Hossain, D. H. Oh

This study aimed to examine the potential link between *Bacillus cereus* biofilm formation, virulence, and pathogenicity. The biofilm formation abilities of nine *B. cereus* strains isolated from food and two reference strains (ATCC 10876 and ATCC 25621) were measured using a crystal violet assay. Among the tested strains, three strains (GIHE 617-5, GIHE 86-09, and GIHE 728-17) and both reference strains were capable of biofilm formation. A positive correlation was obtained for higher cell surface hydrophobicity and increased biofilm formation. In contrast, HPLC analysis for elevated autoinducer-2 (AI-2) production revealed a negative impact on biofilm formation. PCR data indicated that all tested strains were capable of producing common *B. cereus* enterotoxins, including Hbl—A, C, and D, CytK, Nhe—B and C, EntFM, and BceT, but were negative for production of the emetic toxin cereulide and the pore-forming toxin Hly II. Meanwhile, RT-PCR data revealed a close correlation between high biofilm formation and the upregulation of several tested virulence genes for selected strains. However, elevated upregulation of virulence genes was not consistent in all of the higher biofilm-forming strains. Cytotoxicity analysis revealed higher virulence characteristics compared to those of low biofilm-forming strains.

2. Manpower Development(Training/Fellowship/Workshop/Meeting)

2.1 Attended in Training/Fellowship/Workshop/Meeting

Sl. No.	Title of the program	Date	Place	No. of Participants
1	IAEA RAS 1028: Regional training course on Significant and importance of dosimetry system and associated uncertainty for radiation processing facilities	13-17 November, 2023	Bangkok, Thailand	2
2	PPR-2008 and Public Procurement Management-2024 Training Course	28 January - 8 February, 2024	TI, AERE	1
3	IAEA RAS 1028: Mid-Term Review Meeting	4-8 March, 2024	Suzhou, China	1
4	IAEA RAS 1028: Regional training course on Quality assurance and quality control for Gamma dosimetry applications	24-28 June, 2024	Quezon City, Philippines	1

3. Organize Training/Fellowship/Workshop/Meeting

Sl. No.	Title of the program	Date	Place	No. of Participants
1	Organizational Attachment Training for the Diploma in Engineering (Food Technology)	30 June - 30 September, 2023	FSQAD, IFRB.	5

4. Oral/Poster Presentation in Seminar/Symposium/Conference (National and International):

Name of the Participant	Title of Oral / poster presentation	Title of the event	Organizer	Date	Place
Dr. Roksana Huque	Food Authentication of Milk and Rice using Isotopic and Elemental Composition	International Symposium on Food Safety and Control	IAEA	27-31 May, 2024	Vienna, Austria

6. Collaboration work/ MOU (ADP/ FNCA/ MEXT/ FTC/ IAEA/ RCA/ TC/ S&T/ CRP/ In-house project, Universities, etc)

6.1 Forum for Nuclear Cooperation in Asia (FNCA)

Title: Combating Food Fraud using Nuclear Technology

Period:

This project seeks to create an affordable food provenance technology platform using nuclear technology for FNCA member countries, with the goal of reducing fraud in the supply chain. Additionally, it aims to develop a regional fingerprint database to combat fraudulent activities and support business and trade among FNCA member nations. The food commodities of interest are seafood (specifically black tiger prawns) and agricultural products (spices). The analysis focuses on trace elemental analysis, stable isotope analysis, and detecting adulteration. Samples of black tiger prawns have been collected from both wild and farmed sources. Further research is ongoing

6.2 IAEA RCA project (RAS)

Title: Applying Stable Isotope Techniques to Assess Protein Quality of Sustainable Food Sources for the Improvement of Maternal and Child Nutrition

In the Asia-Pacific region, plant proteins are the primary protein source, with cereals like wheat, rice, and maize being predominant. Plant proteins are often perceived as deficient in essential amino acids, particularly lysine and tryptophan. However, this may be less significant when consuming a variety of plant-based proteins. New analytical methods are needed to evaluate dietary amino acid and protein quality to update dietary protein requirements for infants, children, and women of reproductive age. In Bangladesh, lentils have been selected for study, focusing on the amino acid methionine using the IAAO method, with further research ongoing.

6.3 IAEA RCA project (RAS 1028)

Title: Improving the quality management practices in radiation processing facilities for better performance and applications

Radiation processing technologies play an important role in material processing as well as the sterilization and decontamination of various products. This regional project has been thoughtfully designed to support the enhancement and establishment of radiation processing technologies within industrial gamma and electron beam facilities. It primarily focuses on ensuring the safe and efficient operation of radiation processing in industry, agriculture, and environmental contexts. Notably, the reliability and accuracy of the dosimetry systems within radiation infrastructures are significant considerations. Critical areas requiring attention include Quality Assurance/Quality Control (QA/QC), intercomparison dosimetry, and quality management systems.

6.4 Ministry of Science & Technology S &T projects (Project ID# SRG231171)

Title: Prevalence of Antibiotic Resistance Foodborne Pathogens in the Slums in Dhaka City

Period: July, 2023 - June, 2024

The Project entitle “the Prevalence of Antibiotic Resistance Foodborne Pathogens in the Slums in Dhaka City” was performed under a Special Allocation Project for the Year 2023-2024 of the Ministry of Science & Technology. In this project, *Salmonella* and *Shigella* were isolated in the slums of Dhaka city and their antibiotic resistance scenario were investigated. Different types of samples such as raw vegetables; soil and water were collected from 15 different slums. The highest *Salmonella* count was found to be 1.83×10^5 cfu/gm in Slum 4, and 3.5×10^6 cfu/gm of *Shigella* count was found in the Slum 14. The lower than detection count was observed in the slum 3. Meanwhile, in wet soil samples, *Shigella* count was higher in slum 14 and *Salmonella* count was 2.24×10^5 cfu/gm in slum 11. In water samples, both bacterial counts were very negligible. Antibiotic resistance properties of the selected *Salmonella* and *Shigella* strains were analyzed using disc diffusion methods and PCR, where *Salmonella* strains were showed higher resistance to *sul1* gene (sulfonamide), and *Shigella* strain was showed *cat1* gene (Chloramphenicol). Meanwhile, the ciprofloxacin

showed highest level of sensitive against both tested bacteria than others antibiotics. Pathogenicity of the isolated strains such as biofilm formation abilities of both bacteriawas investigated.

7.5 Ministry of Science & Technology R & D projects (Serial No 18, Reg. No 34)

Title: Development, Optimization, and Quality Characterization of Elephant Apple (*Dillenia indica*) Juice Enriched Red Amaranth (*Amaranthus gangeticus* Linn) Jelly: A Natural Colored Phytochemical Rich New Confectionery Product for Human Consumption

Commercial synthetic-colored jellies are facing declining consumer acceptance due to high sugar content and lack of natural pigments. Consequently, the confectionery industry is seeking healthier alternatives. Vegetables like red amaranth, though perishable, are rich in natural red-colored phytochemicals. This study aimed to develop natural-colored, healthy jellies using underutilized resources: red amaranth extract and elephant apple juice. The objectives were to develop the jelly, evaluate its nutritional quality, sensory properties, texture, mineral compositions, and physicochemical and phytochemical potentials. Standard methods were used to measure nutritional parameters, mineral composition, and phyto-physicochemical properties, as well as sensory and texture profile analyses. Results showed significant distinctions in nutritional parameters, energy values, mineral composition, sensory attributes, textural properties, and phyto-physicochemical properties among the formulations and commercial jellies. This study demonstrates the potential of using red amaranth and elephant apple in creating natural-colored, phytochemical-rich, healthier jellies, impacting the confectionery industry and local economy.

8. Service Rendered:

Sl. No.	Name of service provided	Number/ quantity of sample/patient/service	Revenue income
1.	Protein (Food, feed and herbal supplement samples)	15	15000/-
2.	Ash (Food, feed and herbal supplement samples)	2	1000/-
3.	Iron (Food, feed and herbal supplement samples)	1	1500/-
4.	Calcium (Food, feed and herbal supplement samples)	1	1000/-
5.	Lipid (Food, feed and herbal supplement samples)	1	1000/-
6.	Sugar (Food, feed and herbal supplement samples)	1	1000/-
7.	Carbohydrate (Food, feed and herbal supplement samples)	1	2500/-
8.	Total Calories (Food, feed and herbal supplement samples)	1	1500/-

Gamma Source Division, IFRB

Objective

GSD is the pioneer irradiation service provider in Bangladesh. The main objectives of this division are to provide irradiation services in research and commercial sectors and to develop and utilize gamma irradiation technology for better quality products. Gamma Source Division (GSD) of Institute of Food and Radiation Biology (IFRB) has been rendering irradiation services since 1979 to different institutes/organizations and private companies using Co⁶⁰ panoramic gamma irradiator. GSD has provided irradiation services for research purpose to 11 different government (including institutes of BAEC) and private organizations at free of cost during July, 2023 to June, 2024. Moreover, GSD rendered commercial irradiation services to 10 food industries and 45 medical and pharmaceutical companies of Bangladesh. The radioactivity of the source was 1035.26 TBq (27.98 kCi) on 1st July, 2023 and 968.29 TBq (26.17 kCi) on 30th June, 2024.

1. R&D work(s)

1.1 Utilization of Co-60 Gamma Irradiator of GSD in Research and Development (R&D) Purposes

Arifatun Nahar, Md. Firoz Mortuza, Md. Tauhidul Islam Tanim, Md. Ariful Hoque, Md. Khalid Hossain, Md. Humayun Kabir, Md. Nasim Sheikh and Mahfuza Khan

The Gamma Source Division (GSD) of Institute of Food and Radiation Biology (IFRB), Bangladesh Atomic Energy Commission (BAEC) provided irradiation services for R&D purposes to 11 (Eleven) government and

private organizations at free of cost during the reporting period. GSD has provided irradiation services for research purpose to various divisions/institutes of BAEC, Bangladesh Forest Research Institute (BFRI), Bangladesh Jute Research Institute (BJRI), Bangladesh Rice Research Institute (BRRI), Gazipur, Bangladesh Institute of Nuclear Agriculture (BINA), Mymensingh, Al-Madina Pharma Ltd., Emami Bangladesh Limited, Polytech International, UniMed UniHealth Pharmaceutical Ltd, Square Pharma Ltd. Etc. at free of cost during this time period. GSD provides irradiation service for research purpose to 228 food samples (rice seed, potato, rubber seed, bean seed, jute seed, rice callus, dry fish, spirulina, etc.) and 3,474 medical and pharmaceutical samples (Bone graft, bone chips, amnion graft, skull bone, scaffold, amniotic membrane, ETFE film, DNA sample, bacterial solution, hydrogel, Xylogel 2% Jelly, Eye drop, spirulina powder, chitosan, gelatin film etc.).

1.2 Area Radiation Monitoring of Gamma Source Division (GSD)

Arifatun Nahar, Md. Tauhidul Islam Tanim, Md. Firoz Mortuza, Md. Ariful Hoque, Md. Khalid Hossain, Md. Humayun Kabir and Mahfuza Khan

Radiation monitoring is an essential component of any radiation safety program in a nuclear or radiological facility. Radiation monitoring involves the measurement of radiation dose or radionuclide contamination for reasons related to the assessment or control of exposure to radiation or radioactive substances, and the interpretation of the results. Gamma Source Division of IFRB possesses a Cobalt-60 gamma irradiator. In GSD, area radiation monitoring is performed regularly by responsible personnel or Radiation Control Officers (RCOs). Radiation monitoring is performed with Geiger-Muller counter at three feet above from the ground. Area radiation monitoring was performed with Geiger-Muller counter (Model- DRGE-11 Serial No. 020302) at three feet above the ground at different strategic positions in two different situations: a) source in shield condition and b) source in exposed condition. Radiation monitoring was performed on 18th October, 2023. At that time, the activity of the source was 1012.32 TBq (27.36 kCi). During this area radiation monitoring, radiation dose rates at some positions near Co-60 gamma source were found higher than the other positions. Radiation workers and source operators stay very short period of time at these positions during manual sample handling and source operation. It's worth mentioning that the counts of TLD used by radiation workers were always found within acceptable limit.

2. Manpower Development (Training/Fellowship/Workshop/Meeting)

2.1 Attended in Training/Fellowship/Workshop/Meeting

Sl. No.	Title of the program	Date	Place	No. of Participants
1.	IAEA TC (BGD 5035) Scientific Visit on 'Mass rearing of <i>Aedes</i> species including the irradiation procedures aimed to the application of SIT programs'.	10-21 July, 2023	CAA, "Giorgio Nicoli", Crevalcore, Bologna, Italy	01(Dr. Mahfuza Khan)
2.	Final RCM on 'Simultaneous Application of SIT and MAT to Enhance Pest Bactrocera Management', Joint FAO/IAEA CRP Contract No. 23135(Code D41027).	22-25 April, 2024	Vienna, Austria (virtual)	01(Dr. Mahfuza Khan)
3.	International Conference on 'Ocean Prosperity: Catalyzing Blue Economy in Bangladesh'.	03 July, 2024	Bangabandhu International Conference Center (BICC), Sher-e-Bangla Nagar, Dhaka, Bangladesh	01(Dr. Mahfuza Khan)
4.	IAEA TC (BGD 5035) Scientific Visit on "Standard Laboratory with Focus on Procedures of Adult and Pupae Irradiation under Operational Conditions" Vienna, Austria, from 9 to 13 October 2023	09-13 October, 2023	Vienna, Austria	01(Dr. Md. Firoz Mortuza)
5.	RCA Project Meeting on "Improving the Quality Management Practices in Radiation Processing	04-8 March, 2024	Suzhou, China	01(Arifatun Nahar)

	Facilities for Better Performance and Applications (RCA)" IAEA RAS/1028.			
6.	IAEA Technical Meeting on “Recent Achievement of Small-Scale Radiation Generators”	27-31 May, 2024	Vienna, Austria	01(Dr. Md. Firoz Mortuza)
7.	TC Regional Training Course on Quality Assurance and Quality Control for Gamma Dosimetry Applications, TN-EVT2400726 (RAS1028)	24-28 June, 2024	Quezon City, Philippines	01(ArifatunNahar)

3. Oral/Poster Presentation in Seminar/Symposium/Conference (National and International)

Name of the Participant	Title of Oral / poster presentation	Title of the event	Organizer	Date	Place
Dr. Mahfuza Khan	Oral presentation on “Influence of Semiochemicals (Eugenol and Zingerone) on Mating Competitiveness and Longevity of <i>Bactrocera dorsalis</i> (Hendel) and <i>Bactrocera zonata</i> (Saunders)”	Final RCM: IAEA CRP Contract No. - 23135 (Code: D41027).	Joint FAO/IAEA (Virtual)	22-24 April, 2024	Vienna, Austria
Dr. Mahfuza Khan	Oral presentation on “Progress Towards Validating the Sterile Insect Technique as a Key Component of an Area-Wide Integrated Pest Management Programme against <i>Aedes aegypti</i> in Dhaka”	23 rd International Biennial Conference and AGM 2023	Zoological Society of Bangladesh (ZSB)	26 April, 2024	Nabab Nawab Ali Chowdhury Senate Bhaban, University of Dhaka
Anika Tahsin, Md. Abdul Bari, Afroza Sultana and Mahfuza Khan	Poster presentation on “Oviposition preferences of <i>Aedes aegypti</i> (L.) (Diptera: Culicidae) in Bangladesh under laboratory condition”	23 rd International Biennial Conference and AGM 2023	Zoological Society of Bangladesh (ZSB)	26 April, 2024	Nabab Nawab Ali Chowdhury Senate Bhaban, University of Dhaka
Dr. Mahfuza Khan	Oral presentation on “Validating the Sterile Insect Technique as a Key Component of an Area-Wide Integrated Pest Management Programme against <i>Aedes aegypti</i> in Dhaka”	Technical Committee Meeting of Dhaka North City Corporation (DNCC)	DNCC	11 June, 2024.	DNCC, Gulshan, Dhaka, Bangladesh
Dr. Md. Firoz Mortuza, Arifatun Nahar, Md. Tauhidul Islam Tanim, Md. Ariful Hoque, Md. Khalid Hossain, Md. Humayun Kabir, Md. Tawhidul Islam Samsad and	Poster Presentation on ‘alibration of radiation dosimetry system and optimization of dose delivery process for phytosanitary irradiation and food preservation of Bangladesh’.	International Symposium on Food Safety and Control	IAEA	27-31 May, 2024	Vienna, Austria

Mahfuza Khan					

4. Collaboration work/ MOU (ADP/ FNCA/ MEXT/ FTC/ IAEA/ RCA/ TC/ S&T/ CRP/ In-house project, Universities, etc)

4.1 Project Title: Improving the Quality Management Practices in Radiation Processing Facilities for Better Performance and Applications (RCA); Project - IAEA Regional TC:RAS/1028. Dr. Firoy Mortuza is working as Additional National Counter (ANPC) part of this project. Others divisional members are the national team members of this project. Period: 2022-2025

4.2 Project Title: Determination and validation of generic phytosanitary irradiation dose of insects pests (Order: Lepidoptera) of food commodities highlighting on the effects of irradiation dose-rates (Research Contract No. 25011; Project Code:D61026). Dr. Firoy Mortuza is the Chief Scientific investigator and Arifatun Nahar is Additional Chief Scientific Investigator of this project. Others divisional members are working as scientific staff in the project. Period: 2022-2026

4.3 Project Title: ‘Enhancing the Capacity and the Utilization of the Sterile Insect Technique for Aedes Mosquito Control’. IAEA non- RCA Project: RAS/5/095. Dr. Mahfuza Khan is working as National Counter Part (CP) and Scientific Officers of Insect Biotechnology Division (IBD) and Gamma Source Division (GSD) are working as Team members of this project. Period: 2022-2025

4.4 Project Title: ‘Validating the Sterile Insect Technique (SIT) as a Key Component of an Area-Wide Integrated Pest Management (AW-IPM) Programme against *Aedes aegypti* in Dhaka’ IAEA Technical Cooperation Project BGD 5035. Dr. Mahfuza Khan worked as National Counter Part (CP) and Scientific Officers of Insect Biotechnology Division (IBD) and Gamma Source Division (GSD) are working Team members of this project. Period: 2022-2025.

5. Service Rendered

Sl. No.	Name of service provided	Number/ quantity of sample/patient/service	Revenue income
For Research & Development (R&D) Purpose			
1.	Food sample irradiation	228 pcs	Free of cost
2.	Medical and pharmaceutical sample irradiation	3474 pcs	
For Commercial Purpose			
1.	Food product irradiation	35349 kg	15,46,080/-
2.	Medical and Pharmaceutical products irradiation	3105 cft	18,50,800/-
Total = (Thirty-three lac ninty six thousand eight hundred eighty taka only)			33,96,880/-

6. Nature of secretariat work done

- Dr. Mahfuza Khan. 2023. Worked as member of ‘National Technical Committee of Human Recourse Development’ ((NTCHRD) (2022-2024).
- Dr. Mahfuza Khan. 2023. Attended different meetings as stakeholder of ‘Agriculture and Food Products Divisional Committee’ (2022-2024), BSTI, Ministry of Industry.
- Dr. Mahfuza Khan. 2023-2024. Attended different meetings of ‘Central Safe Food Management Coordination Committee’, BSL Office, Ministry of Industry.
- Dr. Mahfuza Khan. 2023. Attended different meetings (virtual) of IDRCC.

- v. Dr. Mahfuza Khan. 2023-2024. Worked as member of the Evaluation Committee of ‘International Centre for Genetic Engineering and Biotechnology Coordinated Research Projects (ICGEB CRPs)’.
- vi. Dr. Mahfuza Khan. 2023. Worked as ‘Director’, executed administrative responsibility, and Head of Gamma Source Division (GSD) (additional in charge), Institute of Food and Radiation Biology (IFRB), AERE, BAEC.
- vii. Dr. Mahfuza Khan. 2023. Worked as ‘Seminar Convener’, (2023), Institute of Food and Radiation Biology (IFRB), AERE, Savar.
- viii. Dr. Mahfuza Khan. 2023. Organized Expert Missions of IAEA Experts, i. Dr. Hananno Yamada and i. Dr. Mr. Marc Vreysen (12-16 November, 2023) under IAEA TC-BGD- 5035 and IAEA RAS/5095, respectively.

Insect Biotechnology Division, IFRB

Objective

This division is engaged in developing the methods of management of insect pests and Phytosanitary treatment using nuclear, microbial, phytochemical and biotechnological approaches. R & D activities conducted for the reporting period are given below:

Activities

1. R&D work(s)

1.1 Impact of Three different types of Water Media on the Life stages of *Aedes aegypti* under Laboratory conditions

A. Ghosh, M. F. Hossain and K. Seheli

In this research work, we studied the effects of three different types of water media (deionized, distilled, and tap water) on the developmental stages and quality parameters of *A. aegypti*. The study was aimed to find more affordable ways to improve mass-rearing protocol toward the implementation of sterile insect techniques. In this experiment, a suitable rearing media for *A. aegypti* mosquito in laboratory conditions was selected by assessing the mosquitoes' tolerance to variations in water quality with respect to electrical conductivity (EC), dissolved oxygen (DO), total dissolved solids (TDS), and pH. According to the obtained data, laboratory used tap water is moderately hard and has no noticeable effect on the growth and quality of *A. aegypti* mosquito species. These results might be helpful in cost effective rearing of *A. aegypti* using tap water for the successful implementation of sterile insect technique

1.2 Influence of Semio-chemicals (Methyl Eugenol) on Male Reproductive Organs of *Bactrocera dorsalis* (Hendel) (Diptera: Tephritidae)

M. A. Bari, M. Khan and M. Momen

Bactrocera dorsalis (Hendel), the Oriental fruit fly, is one of the destructive invasive pest world-wide. Males of many *Bactrocera* species belongs to the family Tephritidae are strongly attracted to methyl eugenol (ME), a naturally occurring compound known as semio-chemicals. Different semio-chemicals/male lures have successfully been implemented in the male annihilation technique (MAT), or in-corporated in sterile insect technique (SIT) programme as pre-release treatments. In the SIT, exposing males to ME or protein is a promising post-teneral treatment for males being released. However, very little research was conducted on the effect of this post-teneral treatment on male reproductive organs or the male ejaculate. Therefore, in this study efforts were made to determine the impact of ME incorporated diets as pre-release treatments on male reproductive organs development and enhance mating performance of adult *B. dorsalis* under International Atomic Energy Agency (IAEA) Coordinated Research Project (CRP) No. 23135/R3.

1.2 Influence of Gel-based Larval Diets on the Growth of Pupal and Adult Stages of *Bactrocera dorsalis* (Diptera: Tephritidae)

M. Momen, M. A. Hossain, M. A. Bari and K. Seheli

The fruit fly known as *Bactrocera dorsalis* (Diptera: Tephritidae) is a widespread pest in Bangladesh. In order to control these insects using the sterile insect technique (SIT), it is necessary to produce sterile flies at a mass

scale. A method to rear the larvae of *B. dorsalis* effectively and affordably must be developed urgently. This study on gel-based diets for larval rearing of *B. dorsalis* demonstrated promising results, with a high emergence rate of over 97% and optimal pupal weight 15.18 ± 0.48 milligram. The adult flies that emerged from these pupae reared on this diet were healthier and larger in size. Specifically, male flies had an average wing size of 6.09 ± 0.10 millimeter, while female flies had an average wing size of 6.26 ± 0.06 millimeter. Furthermore, the gel diet was cost-effective and required less maintenance than traditional rearing methods, making it a more sustainable option for larval rearing in laboratory conditions.

1.3 Potential use of *Bacillus subtilis* as a Mosquitocidal Agent Against *Aedes aegypti* Mosquito Larvae

K. Seheli, A. Ghosh and A.Z.A. Bhuiyan

The *Aedes aegypti* mosquito, a tiny but formidable vector of diseases, is infamous for its role in transmitting several devastating illnesses that afflict millions of people worldwide. In this study, mosquitocidal activity of *Bacillus subtilis* has been investigated in a controlled laboratory environment. The mortality of the laboratory reared larvae of *Aedes aegypti* due to the prolonged exposure to *B. subtilis* can primarily be attributed to surfactin protein. In this study, five strains of *B. subtilis* were isolated from soil sample, confirmed by gram and endospore staining along with several biochemical and enzymatic tests. Prior to bioassay procedure, the presence of surfactin in these bacteria was confirmed by the molecular identification through polymerase chain reaction (PCR) followed by the gel electrophoresis. Twenty-five third instar larvae were exposed to each of the five *B. subtilis* isolates at different volume of crude suspension by maintaining optical density 1 and mortality was observed at an interval of 24 hours for up to 72 hours. After 72 hours, 100% (n=25) larval death was reported for all strains at highest volume of tested crude suspension. The longer exposure time is also proportional to the larval mortality. The culture supernatant exhibited significantly higher mortality at lower volume of 15 ml. All these observations suggest that *B. subtilis* can be a potential biopesticide against *A. aegypti* which is a vector of yellow fever, dengue, zika, and chikungunya virus, compared to the hazardous chemical control agents.

1.4 Use of Locally Isolated *Bacillus sphaericus* in the Suppression of *Aedes aegypti* Mosquito Under Laboratory Condition

A. Ghosh, K. Seheli and S.N. Taib

Arboviral diseases such as dengue and chikungunya, transmitted by *Aedes aegypti* mosquitoes, pose significant public health risks in Bangladesh due to the unusually high transmission rates in recent years. This study was aimed to isolate and characterize local strains of *B. sphaericus* to examine their potential as effective biopesticides for controlling *Aedes aegypti* mosquitoes under controlled laboratory conditions. Six *Bacillus sphaericus* isolates previously obtained from paddy field soil samples, were used in this study. PCR was done to confirm the presence of different mosquitocidal toxin genes. Bioassays were conducted by exposing third-instar larvae to various volumes of crude bacterial suspension at specific intervals. Mortality rates were recorded at 24, 48, and 72-hour of exposure. The minimal lethal volume causing larval mortality was identified as 15ml. 100% larval death was observed for all strains at a crude suspension volume of 35 ml after 72 hours. Probit analysis was performed to determine the LC_{50} values. Additionally, the effectiveness of the culture supernatant was compared to crude bacterial suspension at the same concentration, indicating a significantly higher efficacy of the culture supernatant. These findings highlight the potential of locally isolated *Bacillus sphaericus* strains as biopesticides for controlling *Aedes aegypti* mosquito populations in Bangladesh. Further research and field trials are necessary to evaluate the safety, efficacy, and practical application of these biopesticides in mosquito control programs.

2. Manpower Development(Training /Fellowship/Workshop/Meeting)

2.1 Attended in Training /Fellowship/Workshop/Meeting)

Sl. No	Title of the program	Date	Place	No of Participant
1.	Dr. M. Aftab Hossain attended Second Symposium of Teptritid Workers of Asia, Australia and Oceania (TAAO)	May 06-10, 2024	Beijing, China	117

2.	Dr. M. Aftab Hossain attended Second Regional Coordination Meeting of IAEA RAS 5097	May 11-13, 2024	Beijing, China	24
3.	M. Abdul Bari attended FAO/IAEA TC BGD 5035 Fellowship Training on “Field Operations, including Handling and Release procedures, MRR Procedures and Suppression prior to Sterile Males Release	September 04 to November 03, 2023	Petrolina, Brazil	02
4.	Ananna Ghosh attended TC Fellowship Training on “Mass Rearing SOPs, Including Sex Separation” (IAEA TC BGD 5035).	September 04 to November 03, 2023	Petrolina, Brazil	02
5.	Dr. Kajla Seheli attended 3 rd FAO/IAEA Research Co-ordination Meeting (Virtual) on “Mosquito Irradiation, Sterilization and Quality Control” , IAEA coordinated research project D44004	November 6 - 10, 2023	Vienna, Austria	25
6.	Dr. M. Aftab. Hossain, M. Abdul. Bari and Ananna Ghosh attended International conference on Entomological research and development in Last fifty years challenges and way forward	09 March 2024	BARC, Dhaka	185
7.	M. Abdul Bari Participated in the 23 rd International Biennial Conference and AGM 2023 on “Transformation of poverty through Improvement of Health and Innovative Utilization of Bio-resources”	26 th April 2024	Senate Bhaban & Dept. of Zoology, DU	300

3. Oral/Poster Presentation in Seminar/Symposium/Conference(National and International)

Name of the Participant	Title of the oral/poster presentation	Title of the event	Organizer	Date	Place
Dr. Kajla Seheli	“Effect of exogenous factors on sterile <i>A. aegypti</i> male quality”	3 rd FAO/IAEA Research Co-ordination Meeting (Virtual) on “Mosquito Irradiation, Sterilization and Quality Control”, IAEA coordinated research project D44004	IAEA	November 6 - 10, 2023	Vienna, Austria
Dr. M. Aftab Hossain	“Eleven years of fruit fly (Diptera: Tephritidae) surveys and monitoring in Bangladesh”	Second Symposium of Tephritid Workers of Asia, Australia and Oceania (TAAO)	TAAO and IAEA	May 06-10, 2024	Beijing, China
Dr. M. Aftab Hossain	Status of national surveillance and suppression programme of fruit flies in Bangladesh	Second Regional Coordination Meeting of IAEA RAS 5097	IAEA	May 11-13, 2024	Beijing, China
Dr. M. Aftab Hossain	Survey and monitoring of dacine fruit flies in Bangladesh	Short basic nuclear orientation course for BINA scientists’	Training Institute	May 15, 2024	AERE, Savar
Ananna Ghosh	Environmentally friendly method of controlling <i>Aedes aegypti</i> (L.) mosquito in Bangladesh using Sterile Insect Technique (SIT)	International conference on Entomological research and development in Last fifty years challenges and way forward	Bangladesh Entomological Society	March 09, 2024	BARC, Dhaka

4. Collaboration work (ADP/FNC/MEXT/FTC/IAEA/RCA/TC/S&T/CRP/In house project, Universities, etc)

- a) FAO/IAEA Coordinated Research Programme CRP No. 23909/R0 (2020-2025) titled ‘Optimization of γ -Irradiation Process for Mass Sterilization and the Quality Assurance of Sterile *Aedes aegypti* for Field Release Programme’.
- b) FAO/IAEA Coordinated Research Programme CRP No. 23135/R1 (2019-2024) titled ‘Assessment of Simultaneous Application of SIT and MAT to Enhance Management of the Melon Fly, *Zeugodacus cucurbitae* (Coq.) and the Oriental Fruit Fly, *Bactrocera dorsalis* (Hendel) in Bangladesh’.
- c) FAO/IAEA Technical Cooperation Project IAEA TC BGD 5035 (2022-2025) titled ‘Validating the Sterile Insect Technique (SIT) as a Key Component of an Area-Wide Integrated Pest Management (AW-IPM) Programme against *Aedes aegypti* in Dhaka’.
- d) FAO/IAEA Coordinated Research Programme RAS 5097 (2022-2025) titled ‘Strengthening and Harmonizing Surveillance and Suppression of Fruit flies’

Microbiology and Industrial Irradiation Division, IFRB

Objective

MIID is one of the pioneer divisions of IFRB. The division deals with microorganisms closely associated with the health and welfare of human being. MIID is basically involved in doing research and development work on different aspects of radiation microbiology. The R&D activities conducted for the reporting period are given below.

1. R&D works

1.1 Unveiling Microbial Hazards in Street-Vended Fruits and Salads: A Case Study from Dhaka City

Abdullah-Al Mahin, Nazmoon Nahar, Md. Azadul Kabir Sarker, Md. Murad Hossain, and Md. Kamruzzaman Pramanik

Thirty-three samples of fresh-cut fruits and salads were collected and sent to the laboratory in sterile bags under cold chain conditions. They were evaluated for microbiological analysis including total aerobic count, coliform count, faecal coliform count and total fungal count on nutrient, McConkey, M-FC and potato dextrose agar, respectively, under standard conditions. The highest mean aerobic bacterial count (7.47 log₁₀ CFU/g, fecal coliform count (3.7 log₁₀ CFU/g) and fungal count (7.33 log₁₀ CFU/g) were found in papaya and only the mean highest coliform count (5.35 log₁₀ CFU/g) were found in cucumber. Further, *Salmonella* spp. and *E. coli* was detected in 36% and 45% of samples, respectively, using standard culture-based methods. Based on the results of our study, it is clear that fresh-cut street fruits and salads contain *Salmonella* spp. and *E. coli*, pose a significant health risk to consumers.

1.2 Disinfection of Paper Based Cultural Heritage Objects Using Gamma Radiation

Md Zahid Hasan, Tabassum Mumtaz, Md Firoz Mortuza, Md Kamruzzaman Pramanik

Newspapers are conserved for long period of time worldwide as archive document. These can be important witness of culture and historical milestones and therefore proper preservation is important. Newspapers or similar items are made of cellulose based paper and can be deteriorated by cellulolytic molds and bacteria if not preserved properly. Outcomes of the recent research on preservation of cultural heritage materials indicates that low dose of irradiation may be used as an effective method for the preservation of different paper based cultural heritage material including old documents, newspapers etc. To determine the applicability of ionizing radiation for conservation of these materials, different doses of radiation (2.0, 4.0, 6.0, 8.0, 10.0 and 15.0 kGy) by cobalt-60 gamma source was applied to disinfest and disinfect collected old newspaper. Effect of irradiation was determined by analyzing microorganisms. Cellulolytic bacteria and fungi were isolated and will be identified. Irradiation with 8 kGy resulted in stopping growth of microorganisms in selected sample.

1.3 Isolation and Characterization of LDPE Bags Degrading Bacteria from Aminbazar Landfill Soil

Tabassum Mumtaz, Sun Jarin Juthi and A.K.M. Rashidul Alam

Low-Density Polyethylene (LDPE) has been widely used in packaging and wrapping because of its stability and durability. To address the environmental issues related with LDPE waste, numerous studies on the biodegradation of LDPEs have been conducted. Plastic or synthetic polymer remains in the soil for decades without breakdown. Microbial enzymes are one of the most effective biological agents for the biodegradation of LDPEs. The aim of this study was to isolate microorganisms from the landfill soil and to study the microbial growth on LDPE-enriched mineral media before being screened for their degradation capability. Eight gram positive bacterial isolates with distinct mycelial structure and colony morphology were obtained. In a weight loss experiment using liquid culture; dry cell weight (g/100 L) was measured at 0.1% concentrations of LDPE. Biomass was increased for all the bacterial isolates. The weight loss in LDPE sheet by isolate no. 2 and 3 was between 3-4% within 30 days of incubation. Our preliminary experiments indicate good potentiality of these isolates as LDPE degrading bacteria.

1.4 Single Cell Protein: An Alternative Source of Human and Animal Nutrition

Zinat Mahal

Proteins are called the building blocks of all living organisms. As world's population is expanding the shortage of this vital nutrient has become a serious issue. Production of single cell protein (SCP) can minimize the protein shortage to some extent. However using food wastes (waste of fruits, vegetables) as substrate for the production of high nutritious protein product may also lessen environmental pollution. In the light of this, this study aimed at production of single cell protein from *Saccharomyces cerevisiae* using fruit wastes as substrates. In this study pomegranate peels were used as sole carbon source for preparation of fermentation media on which Baker's yeast *S. cerevisiae* was grown. This work can help in SCP production from inexpensive agro waste material.

2. Manpower Development (Training/Fellowship/Workshop/Meeting)

2.1 Attended in Training/Fellowship/Workshop/Meeting

Sl No	Title of the program	Date	Place	Number of participants
1.	Technical Meeting on 'Quality Management in Wastewater Treatment Using Ionizing Radiation' from in	28 Aug- 1 Sept 2023	Suzhou, China.	01 (Dr Tabassum Mumtaz)
2.	3rd Research Coordination Meeting on 'Radiation based technologies for treatment of emerging organic pollutants'	24-28 June, 2024,	Vienna, Austria.	01 (Dr Tabassum Mumtaz)
3.	2 nd and 3 rd Meeting of Soft Drinks and Beverages Committee 2022-24	29 May, 2024 and 12 June, 2024	Man Bhaban, BSTI, Tejgaon, Dhaka, Bangladesh	01 (Dr Tabassum Mumtaz)
4.	2nd RCM on "Improving the Utilization of Nuclear Techniques for Cultural Heritage Characterization, Consolidation, and Preservation"	14-18 August, 2023.	Bangkok, Thailand	01 (Dr Md Kamruzzaman Pramanik)
5.	Second Research Coordination Meeting	03 -06 Oct 2023	Vienna, Austria	01 (Dr. Abdullah-Al-Mahin)
6.	Workshop on Radiation Processing and Polymer Modification (RPPM) for Agricultural, Environmental and Medical Applications	23 – 26 Jan, 2024	Manilla, the Philippines	01 (Dr. Abdullah-Al-Mahin)
7.	Training course on Radiation Protection for Radiation Workers and RCO's of BAEC, Medical Facilities and Industries	02 – 06 June, 2024	TI, AERE, Savar	01 (Md Shafiul Alam Sarker)

3. Oral/Poster Presentation in Seminar/Symposium/Conference (National and International)

Name of the Participant	Title of oral/ poster presentation	Title of the event	Organizer	Date	Place
Dr Tabassum Mumtaz	Oral presentation on 'Environmental Applications of Radiation Technologies in Bangladesh'	International Conference on Science and Technology (ICNST 2024)	Nuclear Society of Iran	6-8 May, 2024	Isfahan, Iran (Online participation)

4. Service Rendered

Sl NO.	Name of service provided	Number/ quantity of sample/ patient service	Revenue income
1.	Microbiological analysis	66	252000.00

Radiation Entomology and Acarology Division, IFRB

Objective

The R & D activities of Radiation Entomology and Acarology Division focuses on development of environmentally safe integrated pest management techniques against agricultural insect pests of economic importance by using gamma radiation, sterile insect technique (SIT), biodegradable botanicals, hormones, pheromones, biological control agents and insecticides. REA division also working on cost effective insect feed for poultry and fish against soymeal, fishmeal protein and harmful tannery waste. Recently, this division has been focusing on feasibility study of maggot (fly larvae) therapy for diabetic and other wound/ulcer treatment.

Activities

1. R&D work(s)

1.1 The Impact of Sawdust Volumes on the Pupation of the Australian Sheep Blowfly, *Lucilia cuprina* (Diptera: Calliphoridae)

Applications using the Sterile Insect Technique (SIT) require a cheap and efficient method for producing a large number of high-quality sterile insects. We studied the impact of sawdust volume on the pupation of sheep blowflies, *Lucilia cuprina*, across a variety of larval to sawdust ratios. The lowest effective volume of sawdust was determined by comparing sawdust volume to larval volume at seven different ratios (1:1, 2:1, 2.5:1, 3:1, 3.5:1, 4:1, and 5:1) under dark conditions, including naked pupation (i.e., no substrate). Sawdust ratios of 2.5:1 or higher have been demonstrated to be useful for larvae. Reductions in sawdust to larvae ratio (<2.5:1), pupal recovery, and adult emergence were seen after naked pupation. Finally, it is recommended to apply sawdust to larvae at a ratio of at least 2.5 to 1, but larger amounts can be used safely considering the handling procedure, cost effectiveness and availability.

1.2 Metagenomic Analysis of Macadamia Nut Predators: to Identify Specific Pests Consumed by Predators

Without incurring any costs to the grower, predators are crucial to integrated pest management (IPM). To maximize the labor cost, it is required to know which predators consume a particular pest. Here, we used DNA studies to determine the pests that consumed by predators of Macadamia. To identify which predators were eating which pests in the macadamia environment, we first verified the species identities of the predators and subsequently performed a metagenomic study of their gastrointestinal contents. Extracted DNA from the guts of predators was amplified by using primers LCO and HCO, and the resulting material was sent to the Australian Genome Research Facility (AGRF) for sequencing. The genomic material was extracted after sequencing and compared to the genomic data already stored in the Bold, a genomic library. **Metagenomic analysis** revealed that 34 individual pests were identified from the predator's gut, which represents 18 species and 3 families, as follows: 16.66% were moths, Noctuidae (*Spodoptera frugiperda*, *Spodoptera litura*, and *Spodoptera exigua*); 61.11% were Aphids-AAphididae (*Myzus persicae*, *Sipha flava*, *Melanaphis sacchari*, *Aphis gossypii*, *Aphis aurantia*, *Sitobion avenae*, *Diuraphis noxia*, *Rhopalosiphum maidis*, *Acyrtosiphon pisum*, *Nearctaphis bakeri*, and *Buchnera aphidicola*) and 22.23% were Weevils, Curculionidae (*Storeini* sp., *Melanterius* sp., *Trigonopterus* sp., *Sitophilus oryzae*). This is the first analysis of this kind research in macadamia in Australia.

1.3 Increase the Storage Duration of Different Pulses, Wheat, Peanut, Rice and Sundried Fishes by Gamma Radiation

Each year in Bangladesh, different storage cereals like pulse, bean, wheat, peanut and rice are damaged by beetles (*Tribolium castaneum*, *Callosobruchus chinensis*, *C. maculatus*), weevil (*Sitophilus oryzae*), and sundried fishes and fishes products are infested by *Dermestes maculatus*. Also, after long time storage, these products are contaminated by microbial organism ((bacteria, fungus, moulds, yeast, and staphylococcus sp). In this study, different types of pulses wheat, peanut and rice were irradiated by 0.5, 1 and 1.5KG, and sundried fish (churi) was exposed radiation dose (from 0.5KG to 2.2KG). After 12 months, it was observed that both *Tribolium castaneum* and *Sitophilus oryzae* attacked stored products, among them 70% are *Tribolium castaneum* and 30% are *Sitophilus oryzae*. Control wheat, lentil, mung bean, and rice are affected by 70%, and peas, chicken pea and peanut are damaged by 55%. Irradiated products (from 0.5 to 1.5) of wheat, lentil, mung bean, and rice are attacked by insects, but chicken pea and peanut are not damaged, and some irradiated peas are affected. Control dry fishes are damaged (80%) by *Dermestes maculatus* within 3 months, while irradiated samples are not infested, but affected by fungus. Also, it was noticed that if moisture, polypropylene package quality and thickness would be improved, then stored products would be managed without insects and fungus.

2. Manpower Development

Sl. No:	Title	Place	No. of participants
1.	In- house training session	REA division	6

4. Collaboration Work

Agreement for academic co-operation between Faculty of Science (5 years from June 2020), Yamaguchi University, Japan and Institute of Food and Radiation Biology (No. IFRB- PCM5, REA-8) entitled “Ecological approach to the Lepidopteran insects in relation with environmental adaptation and population management”.

A collaborative work is being established with Applied Biosciences, Macquarie University, Sydney on “feasibility study of maggot (fly larvae) therapy for diabetic and other wound/ulcer treatment.”

Cytology and Biocontrol Research (CBR), Radiation Entomology and Acarology Division (READ), IFRB

Fundamental research based on the BAEC previous perspective plan 1993-2010 (IFRB-PCM-2-REA-4, IFRB-PCM-2-REA-5, IFRB-PCM-5-REA-7, IFRB-PCM-7-REA-9) with special focusing on biology, cytology, cytogenetics and biocontrol of dipteran insect pests has been continuing at Cytology and Biocontrol Research (CBR) (founded in 15 Nov 2020), Radiation Entomology and Acarology Division (READ) of IFRB. The purposes of CBR, READ are mainly focused on the following sectors of 8FYP: Sector 4 Agriculture (Strategies for Agriculture and Water Resource Management; Crop Subsector; Strategies for promoting sustainable agriculture and green growth; Integrated Pest Management), Sector 8 Environment and Climate Change (Sustainable Development: Environment and Climate Change), Sector 10 Health (Health, Population and Nutrition) and Sector 14 Social Protection (Social Security; Social Welfare and Social Inclusion; Food Security; Gender Equality and Women Empowerment) and UN-SDGs. CBR scientists are the recipients of two international research grants funded by TWAS, UNESCO and SIDA (Trieste, Italy and Sweden). R&D activities related to these sectors are essential in fundamental science and worldwide scientific audience has interest on it.

Objective

Specific objective: To develop long-term environmentally friendly response strategies and novel sustainable tools to protect fruits and vegetables production, export capacities and public health from dipteran insect pests of Bangladesh priority.

General Objectives:

- To study the combination of classical genetics approaches with cytology and cytogenetic strategies for various phenotypes of target dipteran pests.

- b) To study the development of genomic resources for dipteran insects and emphasize how these resources can be used to understand their biology and management.
- c) To improve management of economically and medically important dipteran insects by the early career and established researchers engaged in advancing the discipline of entomology.
- d) To increase the number of tools in the Area-Wide IPM toolbox by introducing novel techniques, studying existing ones, and/or modifying effective tools to new situations around the world.

1. Research and Development (R&D) Works

1.1 Longevity Of Adult Melon Flies from Laboratory Adapted (Old) and Newly Established (Wild) Colonies (Diptera: Tephritidae)

Sterile insect technique (SIT) is increasingly used in the management of fruit fly. Quality control (QC) procedures are important to monitor and maintain high standards of mass-reared insects for SIT. Adult fly longevity is an important element for the field application of SIT. In this experiment, we studied the total longevity of adult melon fly *Zeugodacus cucurbitae* from laboratory adapted (old) and newly established (wild) colonies. To evaluate this parameter continuously mated flies were considered. Flies from both old and new colonies fed on a diet of Sucrose and Yeast (3:1) from the day of eclosion. Significant differences were not observed in the longevity of adult melon flies (both males and females) from newly established and old colonies of *Zeugodacus cucurbitae*. Further experiments are in progress in the laboratory.

1.2 Insecticidal Effects of *Bacillus thuringiensis* on the Larvae of Oriental Fruit Fly, *Bactrocera Dorsalis* (Diptera: Tephritidae)

δ-Endotoxins are made of proteins which are generated from *Bacillus thuringiensis* as crystalline inclusions. As they have insecticidal properties, cry toxins are employed globally as bio insecticides or in genetically modified plants to manage agricultural pests and mosquito populations. Four *Bacillus thuringiensis* isolates were separated from different prawn and shrimp farms to analysis their insecticidal effects. The toxicity of Bt isolates was analyzed *in vivo* by bioassay against second instar larvae of *Bactrocera dorsalis*. Spore - crystal mixture as well as supernatant of four samples was used in the experiments. Larval mortality has not detected in different time intervals in every set of experiments, but some disturbance like agitation was observed among the larvae.

1.3 Structural Variations of Chironomid Chromosomes In Relation with Ecosystem Health of the Surma River, Sylhet, Bangladesh

The present study investigated the structural variations of Chironomid chromosomes in some selected spots of the Surma River, Sylhet in relation to the ecosystem health. Cellular structures, genetic characteristics, and chromosomal features were examined. Three physical parameters and six chemical parameters of the water of Surma river were measured from different spots in different seasons to determine their relationship with chromosome variations. Two types of chromosome structure ($2n=8$) with arm combinations of Pseudothummi cytocomplex (AE, BF, CD and G) were found. Chromosome arm G contained specific variations in case of both types. Study reveals that structural variations in chironomids chromosomes, along with physicochemical parameters, could have valuable insights into Surma River water quality, which will be helpful for the effective aquatic resource management.

2. Attended in Seminar/Symposium/Conference/Workshop/Meeting

Name of the participant	Title of the event	Organizer	Date	Place
Dr. Farzana Yesmin, CSO Dr. Md. Hasanuzzaman, PSO Tahera Hossain, SSO	23 th International Biennial Conference and AGM 2023	Zoological Society of Bangladesh	26 April 2024	Dhaka Bangladesh
Dr. Md. Hasanuzzaman, PSO	Seminar on Dengue and Dengue vector mosquitoes	Zoological Society of Bangladesh and Department of Zoology, DU	17 Aug 2023	Dhaka Bangladesh
Dr. Md. Hasanuzzaman,	Workshop on	Department of	3 December	Sylhet Agricultural

PSO	Vector Borne Diseases	Parasitology, Sylhet Agricultural University (SAU)	2023	University, Sylhet, Bangladesh
Dr. Md. Hasanuzzaman, PSO	Seminar on Aquatic Resources	Department of Aquatic Resource Management, Sylhet Agricultural University (SAU)	4 December 2023	Sylhet Agricultural University, Sylhet, Bangladesh

3. Collaboration work: UNESCO- TWAS Research Grant Project 2022, Trieste, Italy. Title of the project: Karyology in some Dipteran insects. Principal Investigator (PI): Dr. Farzana Yesmin. Duration: 2023-2024 (2 years)

Veterinary Drug Residue Analysis Division, IFRB

Objective

- To build capacity in analyzing food contaminants, including prohibited substances, in accordance with international standards.
- To generate data on the disposition and residue depletion of veterinary drugs in food-producing animals for risk assessment and establishing maximum residue limits (MRLs).
- To investigate the toxicological effects of food contaminants in *in vivo* and *ex vivo* systems.

To safeguard national public health and enhance the export competitiveness of Bangladeshi food products by providing high-quality testing services.

1. R & D work(s)

1.1 Development, Adaptation, and Validation of Nuclear and Related Analytical Methods for Detection and Determination of Contaminants in Food, Feed, and Environmental Samples.

M. J. Islam, M. N. Islam, M. H. Islam, M. M. Nobi, M. M. B. Prince, D. Chakma, C. K. Shaha, M. A. Mannan and A. S. M. Saifullah

To ensure the safety of food, feed, and environmental samples by developing, adapting, and validating precise, accurate, and reliable nuclear and related analytical methods for the detection and quantification of contaminants.

1.2 Conduct Routine Analysis, Collaborative Research, Inter-Laboratory Comparison Testing, and Provide Services Including Training, testing, and tutoring

M. J. Islam, M. N. Islam, M. H. Islam, M. M. Nobi, M. M. B. Prince, D. Chakma, C. K. Shaha, M. A. Mannan and A. S. M. Saifullah

To enhance analytical capabilities, foster collaboration, ensure consistency in testing, and provide comprehensive services to improve the quality and reliability of scientific analyses in food, feed, and environmental sectors.

1.3 Achieve, Maintain, and Expand the Scope of ISO 17025 Accreditation

M. J. Islam, M. N. Islam, M. H. Islam, M. M. Nobi, M. M. B. Prince, D. Chakma, C. K. Shaha, M. A. Mannan and A. S. M. Saifullah

To ensure the highest standards of quality, reliability, and competence in laboratory testing and calibration services by achieving, maintaining, and expanding the scope of ISO 17025 accreditation.

1.4 Depletion Study and Withdrawal Period Calculation of Veterinary Pharmaceuticals in food-Producing Animals

M. J. Islam, M. N. Islam, M. H. Islam, M. M. Nobi, M. M. B. Prince, D. Chakma, C. K. Shaha, M. A. Mannan and A. S. M. Saifullah

To ensure the safety of food products derived from animals treated with veterinary pharmaceuticals by accurately determining the depletion rates of these substances and establishing appropriate withdrawal periods.

1.5 Investigation of the Toxicological Effects of Food Contaminants in *in-vivo*, and *ex-vivo* System

M. J. Islam, M. N. Islam, M. H. Islam, M. M. Nobil, M. M. B. Prince, D. Chakma, C. K. Shaha, M. A. Mannan and A. S. M. Saifullah

To assess and understand the toxicological impacts of food contaminants on biological systems by conducting in-vivo and ex-vivo studies, thereby contributing to the safety evaluation and risk assessment of food products.

2. Manpower Development (Training/Fellowship/ Workshop/Meeting)

2.1 Attended in Training/Fellowship/ Workshop/Meeting

Sl. No.	Title of the program	Date	Place	No. of Participant
1	Regional Training Course on Risk-Based Drug Residue Monitoring in Food	03-07 July 2023	Philippines	1
2	Meeting of the WG on MTSC	14-18 August 2023	Vienna, Austria	1
3	Third Research Coordination Meeting on Depletion of Veterinary Pharmaceuticals and Radiometric Analysis of their Residues in Animal Matrices	21-25 August 2023	Macedonia	1
4	TC Virtual Training on Analytical Instrument Calibration, Maintenance and Basic Trouble Shooting	12-16 February 2024	Philippines	7

3. Oral/Poster Presentation in Seminar/Symposium/Conference(National and International)

Name of the Participant	Title of Oral/ Poster presentation	Organizer	Date	Place
Dr. A S M Saifullah	Residue Depletion Kinetics and Withdrawal Time Estimation of Doxycycline in Tissue of Sonali Chicken Following Multiple Oral Administrations	International Atomic Energy Agency (IAEA),	27-31 May 2024	Vienna, Austria
Md. Hedayetul Islam	Screening Antimicrobial Residues in Chicken Muscle in Bangladesh using Charm II Radio-Receptor Assay Technique	International Atomic Energy Agency (IAEA),	27-31 May 2024	Vienna, Austria

4. Collaboration work/MoU (ADP/FNCA/MEXT/FTC/IAEA/RCA/TC/S&T/CRP/In-house project/Universities, etc):

4.1 Non RCA Project Code: RAS5096

a) Title: "Strengthening Multi-Stakeholder Food Safety Monitoring Programmes for Chemical Contaminants and Residues in Plant and Animal Products Using Nuclear/Isotopic Techniques"

Project counterpart: Dr. A S M Saifullah

Duration: 2022 to 2026.

b) IAEA Coordinated Research Project: D52043

Title: "Depletion of veterinary Pharmaceuticals and Radiometric Analysis of their Residues in Animal Matrices."

Chief Scientific Investigator (CSI): Dr. A S M Saifullah

Duration: 3 March 2020 to 1 June 2025.

c) IAEA TC Project BGD5034

Title: "Enhancing Competence in Nuclear and Complementary Capabilities for Testing/Monitoring Veterinary Drug Residues and Other Contaminants in Food"

Project Counterpart: Dr. A S M Saifullah

Duration: 2022 to 2026.

5. Service Rendered

Sl. No.	Name of Service Provided	Number/Quantity of sample/patient/service	Revenue Income

a	Patient Service		
b	Sample Analysis	43	2,58,000/-
c	NDT Service		
d	Irradiation of Food/Medical Product		
Total		43	2,58,000/-

Plant Biotechnology and Genetic Engineering Division, IFRB

Plant Biotechnology and Genetic Engineering Division is a leading research oriented laboratory in the country. It initiated research on plant tissue culture in the early eighties with micropropagation of forest trees. Later on the other crop plants like cereals, fruit, medicinal, ornamental, vegetable, spices etc. have been included in the program. In the mid-nineties research on *Agrobacterium*-mediated genetic transformation has been initiated with the fiber crop jute and this technique is expanded gradually to other plants of economic importance viz. rice, tomato and Papaya. Now the scientists of this division are doing their research on mutation breeding to improve crop plants besides the previous program.

Objectives

- To develop suitable protocol for disease free and high yielding plantlets production through *in vitro* culture.
- To establish *in vitro* protocol for commercial production of forest, fruit, medicinal and ornamental plants.
- To identify the desired tissue culture derived lines from seed, embryo and anther culture through observational trials and primary yield trials.
- To improve crop plants through mutation breeding using Carbon Ion beam and Gamma irradiations.
- To molecular characterization of mutant lines.
- Green synthesis of nanomaterials and effect study of nanomaterials on plants *in vitro* and *in vivo*

Activities

1. R & D works

1.1 Study on Morphological Changes in Stevia (*Stevia rebaudiana*) Upon Gamma Irradiation and Determination its Clonal Propagation

M. R. Islam, M. T. Jahan, M. A. Islam, M. A. Taher and A. N. K. Mamun

A suitable protocol was developed for *in vitro* clonal propagation of *Stevia rebaudiana* Bertoni from shoots tip and nodal explant. Experiments were conducted to standardize the culture media composition with plant hormone for multiple shoot proliferation and rooting for obtaining plantlets with uniform characteristics like mother plant in terms of growth and habits. Best response towards multiple shoot regeneration was observed from nodal explants on MS basal media fortified with 3.0 mg/l BAP. In this combination an average of 14 shoot were regenerated from shoot tip and 16 shoot regenerated from nodal explant. Multiple shoots were increased up to two to three time higher when they were sub-culture in the same media combination. Plantlets produced profuse rooting within 10 to 16 days after transfer to MS supplemented with different concentrations of IBA, NAA and IAA (0.5-2.5 mg/l). Best root development was obtained in MS containing 1.5 mg/l IBA. Rooted plantlets were transferred to soil for hardening. About 90% plantlets were successfully established to the field condition. For conducting morphological changes radio sensitivity test were performed by determining lethal dose-50 (LD⁵⁰) after irradiated the explants by gamma ray. LD⁵⁰ was 35 gray (Gy) for shoot tip explants whereas 65 gray (Gy) for nodal explants. Some morphological changes were occurred in the treated explants which is significant for induction of mutation.

1.2 Plant Tissue Culture of Sugarcane Var. China (*Saccharum Officinarum* L.) Using Leaf-Sheath

M.H. Kabir*, Pronabananda Das, Md. Monirul Islam, Md. Monirul Islam, M.R. Islam, M.T. Jahan, and A.N.K. Mamun

The effect of various concentrations and combinations of plant growth regulators for *in vitro* propagation of sugarcane var. China was described in this study using leaf-sheath as explants. An efficient and reproducible protocol was developed. Direct multiple shoot formation from leaf-sheath was observed on MS medium

supplemented with 10.0 mg/l NAA, in which 90% explants induced shoots inoculation after 90 days. The average number of shoots formed per explant was 30.0 ± 2.50 and the average shoot length of 7.2 ± 0.50 cm were achieved in this medium inoculation after 90 days. Regenerated shoots rooted well when they were transferred into half strength of MS + 2.50 mg/l NAA, in which 90% shoots rooted within 30 days of inoculation period. The average number of roots produced per shoot was 15.0 ± 1.25 and the average root length of 7.50 ± 2.30 cm was observed in this medium. Ninety percent of the *in vitro* raised plantlets were survived in the natural environment.

1.3 Reduction in Seedling Growth Provides Insights into the Impact of Gamma Irradiation on Rice Genotypes

ANK Mamun, Pronabananda Das, Humayun Kabir and Abu Taher

This study investigates the impact of gamma irradiation on three rice genotypes—Pokkali, Lombur, and Polao—utilizing Growth Reduction (GR) data of seedlings. Seeds were exposed to varying gamma irradiation doses (0, 25, 35, 45, 60, 100 Gy, 200 Gy, 300 Gy, 400 Gy, and 500 Gy), and subsequent seedling growth was analyzed to determine GR50 (50% growth reduction) and GR30 (30% growth reduction) values. For Pokkali, GR50 and GR30 were 135.45 and 60.88, respectively, indicating a moderate response to gamma irradiation. Lombur exhibited GR50 and GR30 values of 138.86 and 55.32, suggesting a similar resilience. In contrast, Polao rice displayed higher sensitivities with a GR50 of 400.72 and GR30 of 238.12, indicating substantial growth reduction. The findings demonstrate genotype-specific responses to gamma irradiation, emphasizing the importance of tailored irradiation doses for different rice varieties. These insights contribute to the optimization of mutation breeding protocols for enhancing crop resilience and productivity. The study underscores the significance of understanding genotype-specific responses to gamma irradiation for informed decision-making in crop improvement strategies.

1.4 Investigation of BARI-1 Bean LD50 Estimation Under Cobalt60 (γ) Irradiation

Pronabananda Das¹, Sajedur Rahman², Humayun Kabir¹, Abu Taher¹, and ANK Mamun¹

¹Plant Biotechnology and Genetic Engineering Division, Institute of Food and Radiation Biology, Bangladesh Atomic Energy Commission, AERE, Savar, Dhaka

²Lal Teer Seed Limited, Plant and R & D Farm, Bashon, Joydebpur, Gazipur

This study aimed to determine the lethal dose (LD50) of BARI-1 Bean (*Phaseolus vulgaris* L.) using gamma irradiation and assess its impact on seed survival. Different gamma irradiation doses, ranging from 100 Gy to 500 Gy, were applied to BARI-1 Bean seeds, alongside a control group. The objective was to identify the optimal irradiation dose for achieving 50% seed survival. Results revealed a dose-response relationship, and at the point of 50% survival, the LD50 was estimated to be 155.34 Gy. This optimized dose demonstrates the threshold at which seed viability is significantly compromised while providing valuable information for future mutation breeding programs. Furthermore, in case of seedling height, the Growth Reduction at 30% (GR50) was determined to be 180.4 Gy, indicating the dosage at which a 30% reduction in growth occurs. This metric offers insights into the impact of gamma irradiation on the developmental aspects of BARI-1 Bean. In conclusion, this study contributes to the understanding of the radiation response of BARI-1 Bean seeds, providing essential information for optimizing gamma irradiation protocols in mutation breeding strategies. The identified LD50 and GR30 values serve as valuable benchmarks for researchers and breeders seeking to induce controlled mutations for crop improvement in BARI-1 Bean.

1.5 Study of Anther Culture of Local Indica Rice Genotype Lombur

Pronabananda Das, M.H. Kabir, Md. Monirul Islam, Md. Monirul Islam, M.R. Islam, M.T. Jahan, and A.N.K. Mamun

Anther culture is a technique used in plant breeding to create homozygous lines quickly and improve selection effectiveness. Regeneration of haploid plants from cultured anthers of rice and subsequent diploidization, resulting in fully homozygous genotypes or doubled haploids, offers an alternative to the traditional approach of inbred-line development, which normally involves multiple cycles of inbreeding. In this investigation, after cold-pretreatment spikes of rice (7 days at 4°C), the anthers were cultured on the callus-induction medium

MS supplemented with 2mg/l 2,4-D, 0.5mg/l Kn and 50mg/l casein hydrolysate plus 60g/l sucrose. The calli were transferred to MS medium supplemented with 1.5mg/l BAP, 0.5 mg/l Kn and 0.5 mg/l NAA where green spots initiated. Multiplication of shoots was found better on MS medium with 2mg/l BAP and initiation of roots on hormone free MS medium. On average, 27% of the plants obtained were albinos and 59% of the green plants maintained and transplanted in the field to assess the morphological traits. Fourty seven regenerants showed normal morphological appearances with 80-95% grain fertility.

1.6 In Vitro Clonal Propagation of Strawberry (*Fragaria Ananassa*) Through Nodal and Shoot Tip Segment.

M. T. Jahan, M. R. Islam, S.A.M. Shariar Islam, P. Das , M. M. Islam Arko, M. M. Islam M. A. Islam, M. H. Kabir and A. N.K. Mamun

In the present investigation attempts were made to standardize a reproducible protocol for *in vitro* clonal propagation of Strawberry (*Fragaria ananassa*). The experiment were conducted by using two different type of explants namely nodal and shoot tip segments obtained from field grown as well as *in vitro* grown axillary buds. For the development of multiple shoots two types of explants mentioned above cultured on to MS fortified with different concentrations of Benzyle Amino Purine (BAP) as well as combination with two specific concentrations of different auxins (IAA and NAA) and cytokinin (Kn). Among the various growth regulators used best response towards multiple shoot regeneration were observed from the nodal segments on MS supplemented with 1.0 mg/l BAP + 0.5 mg/l Kn . In this combination ninety percent explants were regenerated for nodal explant whereas seventy five percent explant were regenerated for shoot tip explant. Average of 12 shoot bud were regenerated from nodal segments on the other hand 06 shoot buds were from shoot tip explants. The number of shoot buds increased 2 to 3 folds and also got elongation when sub-cultured on the same medium.

Shoot development as well as rooting of regenerated shoots is especially important for establishing tissue cultured derived plants. The regenerated shoots did not produce root spontaneously in the present investigation. So for producing complete plantlets *In vitro* raised shoots were separated from the clamp of multiple shoots and they were cultured onto MS and half strength of MS fortified with different concentrations (0.2 mg/l to 1.5 mg/l) of IAA, NAA and IBA. In this experiment the best root development were obtained in the rooting medium containing half strength MS fortified with 0.2 mg/l IBA (Table 2).

About 10-12 days were required for getting healthy root formation. It has been reported that IBA is the suitable auxin for adventitious root initiation and it was also found superior to IAA or NAA for its more stable nature. After development of sufficiently healthy roots the plantlets were transferred to small pots containing 1: 1 non-sterilized garden soil and coco-peat and gradually acclimatized to out-door conditions and ultimately transferred to soil. About ninety percent of the plantlets were able survived in natural conditions.

2. Attended in Seminar/Symposium/Conference/Workshop/Meeting

Name of the Participant	Title of the event	Organizer	Date	Place
Mohammed Rafiqul Islam, CSO.	Participated in a RCA meeting entitled “Mid-Term Project Review Meeting, (ME-RAS5088-2302649)	IAEA	16 – 20 October 2023	Beijing, China
Mohammed Rafiqul Islam, CSO.	Participated Regional Training Course on Mutation by Speed Breeding (MbyS) for Abiotic Stress Tolerance.	IAEA	7 to 18 August 2023,	Jakarta, Indonesia
Dr. ANK Mamun, CSO	FNCA JFY2023 Workshop on Mutation Breeding Project	FNCA	26-28th September, 2023	Takasaki, Japan
Dr. ANK Mamun, CSO	Regional workshop on accelerating Climate-Resilient Crop Improvement: Optimizing Speed Breeding for Plant Mutation Breeding Application	IAEA	15-19 April, 2024	Hanoi, Vietnam
Pronabananda Das, SSO	“CRISPR-Cas9 Gene Editing Mechanism: A new era in molecular biology”	Bangladesh Society of	5 th May,2024-9 th May,2024	Department of Botany,

		Microbiologist, University of Dhaka		University of Dhaka
Pronabananda Das, SSO	“Workshop on Standard Operating Procedures for Research and Release of Genome Edited Plants in Bangladesh”	SABP	23 rd April, 2024	BRAC CDM, Savar
Scientists of PBGED	Annual Plant Tissue Culture and Biotechnology conference-2023	BAPTC&B, Department of Botany and BCSIR	23 rd December, 2023	BCSIR Rajshahi Laboratories, Rajshahi

3. Collaboration work (ADP/FNCA/MEXT/TC/IAEA/RCA/FTC/S&T/CRP/In house project)

Plant Biotechnology and Genetic Engineering Division (PBGED) has collaboration with International Atomic Energy Agency (IAEA), Regional Cooperative Agreement (RCA) Austria, Forum for Nuclear Cooperation in Agreement (FNCA), Japan and Lal Teer Seed Limited, Gazipur, Bangladesh. At present Scientists of this division engaged in several projects, these are as follows:

01. IAEA/RCA Project entitled, “Enhancing crop productivity and quality through mutation by speed breeding” **RAS5088**.
02. Forum for Nuclear Cooperation in Asia (FNCA) project entitled ‘Mutation Breeding Project’

Molecular Radiobiology and Biodosimetry Division, IFRB

Objectives

Molecular Radiobiology and Biodosimetry Division (MRBD) plays a vital role in preparedness for and response to radiation emergencies and to research in the field of radiation biology at the molecular level for the well-being of mankind. The major objectives of the division are-

- To evaluate the radiation absorbed dose of the accidental radiation-exposed individual by analyzing the extent of chromosomal DNA damage.
- To investigate the DNA damage repair mechanism in extremely radiation-resistant bacteria (e.g. *Deinococcus radiodurans*), whose findings could play important role in biomedical research like cancer and aging.
- To find out the local variety or to develop the mutant variety of microbial strain that could be used for economic, health, and environmental benefits.
- To study metagenomics, epigenetics, gene expression profiling, microbial typing, protein purification, and characterization, etc.

Activities

1. Research and Development Works

1.1 Bacterial Diversity in Fermented Rice (Panta Bhat) Prepared from White and Brown Rice Grains

A.Y.K. M. M. Rana, A. H. M. Kamal, S. Islam, M. Z. Rahman and, P. K. Roy

Rice fermentation, such as in the preparation of 'Panta bhat,' has a rich history, supporting a diverse microbial community. This study focused on the bacterial content in fermented rice prepared from both white and brown rice grains. We examined two types of rice: brown rice, which retains its bran layers through traditional threshing, and polished white rice, which is primarily composed of endosperm. Using metagenomic analysis through Illumina sequencing of the 16S rRNA gene, we uncovered intricate variations in microbial compositions across taxonomic levels. Proteobacteria (71.18-90.10%) and Firmicutes (9.80-28.29%) emerged as the dominant phyla across all samples. Genus-level analysis highlighted the prevalence of *Klebsiella* in the white rice variety (82.18%). In contrast, the brown rice variety exhibited greater bacterial diversity, including *Klebsiella* (23.57%), *Acinetobacter* (17.52%), and *Weissella* (15.5%), among others. Notably, brown rice showcased a broader spectrum of potential probiotics, such as *Lactobacillus acidifarinae* and *Weissella cibaria*, potentially fostered by nutrient-rich bran layers and the rural environments in which they were processed. Conversely, the polished white rice exhibited a more limited range of probiotic species. This study underscores the profound influence of rice grain composition and traditional processing methods

on microbial diversity. Insights into the probiotic richness of brown rice emphasize the pivotal role of bran layers in nurturing diverse probiotic communities

1.2 Evaluation of Various Media's Cryoprotective Capacity to Preserve Probiotic Bacteria's Viability during the Freeze-Drying Process

A. H. M. Kamal, S. Islam, M. Z. Rahman, P. K. Roy and A.Y.K. M. M. Rana

Effective preservation of probiotic bacteria through freeze-drying relies on selecting suitable cryoprotective agents to maintain bacterial viability. This study evaluated the cryoprotective abilities of different media—skim milk, lactose, and honey—at concentrations of 5%, 10%, and 15% for preserving *Lactobacillus rhamnosus* GG ATCC 53103 and *Lactobacillus casei* ATCC 334. Using these media, probiotic suspensions were freeze-dried and then stored at 4°C, 25°C, and 35°C for three months. Viability was assessed by enumerating colony-forming units (CFU/ml) before and after freeze-drying, and during storage. Results indicated that 10% lactose was the most effective cryoprotectant, showing the highest survival rates for both bacterial strains immediately after freeze-drying and throughout storage. This finding underscores the importance of optimizing cryoprotectant concentrations to enhance the stability and viability of probiotic bacteria in freeze-drying processes.

1.3 The Radioprotective Properties of Tomato Extract Lycopene Against Radiation-Induced DNA

S. Islam, A. H. M. Kamal, M. Z. Rahman, P. K. Roy and A.Y.K. M. M. Rana

The accumulation of free radicals is linked to a number of diseases. Free radicals can be scavenged by antioxidants and reducing their harmful effects. It is therefore essential to look for naturally occurring antioxidants that come from plants, as synthetic antioxidants are carcinogenic. Lycopene is one of the carotenoids that dissolves in fat and has antioxidant properties. The impact of lycopene on *E.coli* susceptibility to γ -radiation was examined. These organisms were shielded from γ -radiation-induced inactivation and degradation by the lycopene extracts. The ability of lycopene extracts to shield plasmid DNA from exposure was also examined. The lycopene extracts inhibited the radiation-induced deterioration of the plasmid pUC19 DNA. The plasmid pUC19 DNA experiments suggested that the microorganisms were likely shielded by the lycopene extracts through DNA protection. For cancer patients and others who frequently expose themselves to radiation, lycopene may be a useful plant-based pharmaceutical product for treating a variety of diseases caused by free radicals.

2. Manpower development

Title	Date	Place	No. of participants
In house training	July, 2023 - Jun, 2024	MRBD, IFRB	5
BAEC- JAEA Follow- up “Environmental Radioactivity Monitoring training Course”	29 October, 2023 – 02 November, 2023	Training Institute, AERE, Savar, Dhaka.	01
IAEA Regional Training Course on Next Generation Sequencing (NGS) Using Illumina Platform	09-14 September, 2023	BLRI, Dhaka, Bangladesh	02

3. Attended in Seminar/Symposium/Conferences/workshop/Meeting

Name of participants	Title of the event	Organizer	Date	Place
Safaiatul Islam	The methodologies and findings of epidemiological studies on the health implications of radon exposure	Hirosaki University, Japan	01 December, 2023	IRSC webinar

4. Collaboration Work

- S & T Project, entitled “Study of chromosome abnormalities (dicentrics and rings) in thyroid cancer patients before and after iodine-131 treatment”, Principal investigator: Dr. Md. Ziaur Rahman, Associate investigator: Dr. Protul Kumar Roy (Project ID: SRG - 235580)

- R & D Project, entitled “Analysis of Radiation Induced Chromosomal Aberrations in Irradiated Peripheral Blood Samples from Healthy Individuals”, Project Director: Safaiatul Islam (Group ID: Biology, Medical Science and Nutrition - 35)
- IAEA RAS5085 Project “Using nuclear derived techniques in the early and rapid detection of priority animal and zoonotic diseases with focus on Avian Influenza”. Project Counterpart (Cycle: 2020 - 2023): Dr. Protul Kumar Roy
- IAEA ZODIAC (Zoonotic disease Integrated Action) Project (Cycle: 2020 - 2025). ZODIAC National Coordinator: Dr. A. Y. K. Md. Masud Rana

INSTITUTE OF TISSUE BANKING AND BIOMATERIAL RESEARCH (ITBBR), AERE

Each year, thousands of people in Bangladesh suffer from burns, surgical wounds, and bone-related issues. The Institute of Tissue Banking and Biomaterial Research (ITBBR) is dedicated to reducing human suffering by producing clinically safe and cost-effective tissue allografts for use in various fields such as ophthalmology, orthopedics, burn and cosmetic surgery, and oral and maxillofacial surgery. Recently, ITBBR has expanded its efforts to include the processing and banking cranial bone autografts. The institute is also researching various biomaterials, including amnion, human bone, bovine bone, rabbit collagen, plant extracts, and mesenchymal stem cells derived from amniotic fluid and cord blood. Additionally, ITBBR is developing synthetic grafts, and artificial bone substitutes for orthopedic reconstructive surgery.

Programme(s)

1. Research and Development work(s)

1.1 Processing and Preservation of Allogenic Cancellous Bone Chips for Use as Osteoconductive Fillers in Bone Void Treatments

M. H. Adnan, F. Diba, T. A. Arafat, P. C. Karmakar, M. S. Rahman, N. Akhtar, S. M. Asaduzzaman

Allogenic cancellous bone chips are considered a promising graft material for addressing complex skeletal defects, including spinal issues, congenital deformities, degenerative bone diseases, fractures, non-union gaps from trauma, oral and maxillofacial defects, and cysts or cyst-like tumors. Cancellous bones, such as femoral heads and condyles, are sourced from clinically suitable live donors undergoing surgical procedures and are initially stored frozen in hospitals. Once transported to the tissue banking lab, the femoral heads are dissected using a surface-sterilized electric band saw under sterile conditions. Radiation treatment is used to inactivate or kill microorganisms present in the tissue products. Following ITBBR’s protocol, which aligns with IAEA recommendations, the bone tissues are pasteurized, processed, radiation sterilized, and preserved. Between July 2023 and June 2024, 12,720 cc of radiation-sterilized bone allografts were prepared, and 11,436 cc were supplied for orthopedic reconstruction surgeries.

1.2 Procurement, Preparation, and Sterilization of Human Amniotic Membrane for Injured Skin and Soft Tissue Repair and Regeneration

F. Diba, P. C. Karmakar, T. A. Arafat, M. H. Adnan, M. S. Rahman, N. Akhtar, S. M. Asaduzzaman

Human amniotic membrane (HAM) is a widely recognized biological dressing used in ophthalmic surgery, plastic and cosmetic procedures, abdominal and vaginal reconstructions, and skin repair surgeries. Its notable properties include promoting epithelial cell motility, improving basal cell attachment, and facilitating epithelial differentiation. Following normal vaginal deliveries, amniotic sacs are obtained from healthy, disease-free donors. The amnion is carefully separated from the chorion using sterile surgical instruments, thoroughly washed with sterile physiological saline (six to eight times), placed on sterile surgical gauze, and dried overnight at 40±1°C. The dried membranes are then cut into standard sizes, such as 17 cm x 10 cm, 10 cm x 10 cm, and 5 cm x 5 cm, packed in polythene envelopes, vacuum-sealed, and labeled in a laminar flow cabinet. They are then sterilized by gamma irradiation at a dose of 25 kGy. During the reporting period, 1,305 amniotic sacs were processed, 5,178 amniotic membrane allografts were prepared, and 5124 pieces of amniotic membrane allografts were supplied for use in clinical rehabilitation surgery.

1.3 Radiation-Sterilized Cranial Bone Autografts for Repairing Skull Defects: Processing, Preservation, and Supply

T. A. Arafat, P. C. Karmakar, F. Diba, M. H. Adnan, N. Akhtar, S. M. Asaduzzaman

Autologous cranial bone is highly valued for reconstructive surgery to repair skull defects, which are often caused by injuries, infections, or neurosurgical procedures. The Institute of Tissue Banking and Biomaterial Research (ITBBR) is the sole facility responsible for processing and preserving human cranial bone. Initially, cranial bones are kept frozen at -80°C until processing begins. Upon processing, the bones are thawed to room temperature and handled in a sterile environment. They are treated with povidone-iodine solution, thoroughly rinsed with sterile distilled water, and then double-packaged in polyethylene, vacuum-sealed, wrapped in fabric, and labeled with details such as graft identification number, dose and date of gamma irradiation, preservation conditions, and expiration date.

For additional safety, the packaged bones are wrapped in a third layer of polyethylene. They are sterilized using gamma radiation and stored at -80°C until sterility testing is completed. After passing sterility tests, the cranial bone autografts are supplied to hospitals and clinics. During the reporting period, 523 cranial bone autografts were provided to patients, effectively aiding in the treatment of traumatic head injuries, brain tumors, and strokes.

1.4 Procurement, Processing, and Supply of Radiation-Sterilized Demineralized Bone Granules in the Treatment of Oral and Maxillofacial Surgery

P. C. Karmakar, F. Diba, T. A. Arafat, M. H. Adnan, M. S. Rahman, N. Akhtar, S. M. Asaduzzaman

The use of demineralized bone matrix (DBM) has become an effective technique in the surgical treatment of maxillofacial bone defects. DBM provides growth factors, osteoinductive proteins, and robust mechanical support, with a minimal risk of disease transmission. Due to the removal of minerals, DBM exhibits enhanced biological properties, making it an excellent graft material for regenerating maxillofacial bone. At ITBBR, bone granules are demineralized using 0.6N HCl. During the reporting period, 52 vials of demineralized bone granules were prepared for use in oral and maxillofacial bone defect treatments.

1.5 Microbial Quality Assurance for Tissue Allografts Sterilized by Gamma Radiation

T. A. Arafat, M. H. Adnan, F. Diba, P. C. Karmakar, N. Akhtar, S. M. Asaduzzaman

Effective transplantation of human tissue allografts greatly improves patients' quality of life and can sometimes save lives. However, contaminated allografts can lead to severe illness or death in recipients. To maintain high standards of quality and adhere to good scientific practices, a tissue bank must implement effective technical measures for the procurement, storage, documentation, and transfer of graft materials. Gamma irradiation is widely accepted for the terminal sterilization of tissue allografts due to its precise process control and lack of residue in the treated product. ITBBR has established that 25 kGy of gamma radiation is effective for sterilizing tissue allografts, based on the initial bioburden and contaminant response. During the reporting period, 284 amnion samples from 15 batches, 790 bone samples from 29 batches, and 369 cranial bone samples from 14 batches were analyzed. All samples were determined to be transplant-safe on a microbiologic level.

1.6 Prevalence of Multidrug-Resistant (MDR) Bacteria in Burn Patients and Efficacy of Radiation Sterilized Human Amniotic Membrane Grafts against the Isolated Bacteria

F. Diba, P. C. Karmakar, T. A. Arafat, M. H. Adnan, N. Akhtar, S. M. Asaduzzaman

Burns are the most debilitating injuries worldwide, and multidrug-resistant (MDR) bacteria are a major cause of burn patient morbidity and mortality, especially in developing countries like Bangladesh. This study aimed to identify MDR isolates from burn ICU patients and investigate the efficiency of radiation-sterilized human amniotic membrane grafts against MDR bacteria. Sixty-seven bacteria were studied. The antimicrobial resistance was tested using the disk diffusion method as recommended by CLSI. The assessment of resistance (*bla*_{CTX-M}, *bla*_{VIM-1}, and *bla*_{VIM-2}) and biofilm-forming (*algD*, *pelF*, *pslD*) genes were detected through PCR. The antimicrobial effectiveness of human amniotic membrane (HAM) grafts against MDR isolates at different radiation doses was analyzed. Biochemical characterization identified six bacterial genera (*Pseudomonas*, *Acinetobacter*, *Staphylococcus*, *Klebsiella*, *Proteus*, and *Neisseria*) and confirmed them by 16S rRNA gene sequencing. Among the isolates, we detected *Pseudomonas* spp. (73.1%) to be the most prevalent bacteria.

Most of the isolates showed multidrug resistance (MDR). Isolates were 100% resistant to Chloramphenicol, Ampicillin, Clindamycin, Moxifloxacin, Cefoxitin, and Ciprofloxacin. Isolates resistant to Gentamycin (81.8%), Amoxicillin (90.9%), Azithromycin (72.7%), Amoxiclavate (90.9%), Tazobactam-piperacillin (63.7%), Ceftriaxone (85.7%), Levofloxacin (90.9%), Imipenem (72.7%), Cefepime (81.8%), Meropenem (63.6%) were also detected. High sensitivity was found only in Colistin (81.9%) and Polymyxin B (100%). PCR amplification of sequenced isolates indicated all have the beta-lactamase *bla_{VIM-2}* gene. Only BI-25.3 had *bla_{VIM-1}*. No *bla_{CTX-M}* gene was found among the bacteria. All isolates carried the biofilm-forming gene *alg-D*. The rest of the isolates had *pel-F*, except for BI-41.5 and BI-49.4. *psl-D* gene was found in all the isolates except BI-49.4. We used sterilized human amniotic membrane grafts (HAM) at 5, 10, 15, 20, and 25 KGy radiation to test their antibacterial effectiveness against sequenced MDR strains. Unfortunately, no inhibitory zone was detected. More research and radiation dose optimizations are needed. Limited information on the prevalence of biofilm producers and MDR bacteria in burn units is available. According to the study, strict infection control and antimicrobial stewardship will be crucial to combat patient infection.

2. Attended in Seminar/Symposium/Conference/Meeting

Name of the Participant/Speaker	Title of the event	Organizer	Date	Place
Dr. S.M. Asaduzzaman	Tissue Banking Activities: Research, Development, and Application in Bangladesh	Institute of Tissue Banking and Biomaterial Research, AERE, Savar, Dhaka	26 th May, 2024	National Institute of Neurosciences and Hospital, Agargaon, Dhaka
Dr. Naznin Akhtar	Tissue Banking Activities: Research, Development and Application in Bangladesh	Institute of Tissue Banking and Biomaterial Research, AERE, Savar, Dhaka	29 th June, 2024	Mymensingh Medical College, Mymensingh.

3. Collaboration work/MoU (ADP/FNCA/MEXT/FTC/IAEA/RCA/TC/S&T/CRP/In-house project/Universities, etc.)

Collaborative work with Sheikh Hasina National Institute of Burn and Plastic Surgery (SHNIBPS) on determining the microbiological profile of hospitalized burn patients and the prevalence of drug resistance among the infecting bacteria.

4. Service Rendered

Sl. No.	Nature/name of service	No. of sample	Income
a	Supply of bone tissue allografts (bone chips, massive bone allografts and demineralized bone granules) (cc)	11,800	7,71,500
b	Supply of bone autografts (pcs)	523	
c	Supply of amniotic membrane allografts (pcs)	5,124	99,720
	Total		8,71,220

5. Others

Public and Professional Awareness Activities

Many people in our country are not well-versed in tissue transplantation, a concept that remains relatively new to them. To address this, ITBBR organizes ongoing campaigns nationwide as part of its Public Professional Awareness (PPA) program. These campaigns aim to educate the public about tissue donation, emphasize its life-saving potential, and explain the scientific principles behind transplantation. Additionally, ITBBR holds regular meetings with medical professionals to enhance their understanding and awareness of tissue transplantation practices.

NUCLEAR MEDICINE

NATIONAL INSTITUTE OF NUCLEAR MEDICINE AND ALLIED SCIENCES (NINMAS), SHAHBAG

The National Institute of Nuclear Medicine & Allied Sciences (NINMAS) is the apex Nuclear Medicine facility in Bangladesh and it is located at Bangabandhu Sheikh Mujib Medical University (BSMMU) premise. The Institute provides medical imaging using nuclear techniques and therapeutic treatment services.

Objectives

- To render specialized medical services to the people using nuclear technology.
- To improve and upgrade Nuclear Medicine facilities in Bangladesh.
- To conduct training of physicians, physicists radio pharmacists and technologists in the field of nuclear medicine.
- To conduct academic and research activities.
- To coordinate and standardize the activities of all nuclear medicine establishments of BAEC.

Major Activities

The services rendered by the institute are:

- Clinical (both diagnostic and therapeutic)
- Academic and
- Research & Development.

All services are provided under the following divisions:

- 1) PET-CT Division
- 2) Scintigraphy Division
- 3) Nuclear Cardiology Division
- 4) Nuclear Nephrology Division
- 5) Research and Development Division
- 6) Thyroid Division
- 7) In-vitro Division
- 8) Ultrasound and Color Doppler Division
- 9) Medical Physics Division
- 10) Cyclotron Division

1. Clinical Services

1.1 Diagnostic Activities

- 1) The Institute is equipped with two (2) PET-CT facilities. PET-CT scan is very useful for early diagnosis and staging of cancer for the people of Bangladesh.
- 2) The institute is equipped with three SPECT, one SPECT-CT and one planar Gamma camera. The studies include: Bone scan, Renal scan (DTPA, DMSA, MAG3 with split function and GFR measurements), Cardiac scan (Myocardial Perfusion Imaging- MPI), Hepatobiliary-HIDA scan, Lymphoscintigraphy, GIT bleeding, Meckel's scan, Haemangioma scan, Thyroid Scan, Parathyroid scan, Brain scan, Salivary gland scan, Lung Perfusion scan etc.
- 3) Thyroid Imaging and Uptake.
- 4) BMD (Bone Mineral Densitometry) for early detection of osteoporosis/osteopenia and low bone mass.

- 5) Conventional and Power & Color Doppler Ultrasound Imaging: At present there are 5 Color Doppler's including one 4D, one 3D and three 2D machines. All sorts of diagnostic USG, including normal B-scan of different organs, HRUS of superficial organs and Color Doppler of the vascular system are routinely performed.
- 6) Hormone Analysis: By using the RIA and modern CLIA techniques the In-vitro division is estimating all thyroid-related hormones like T3, T4, TSH, FT3, FT4, LH, FSH, pituitary hormones, estrogen, progesterone, prolactin, testosterone, follicular stimulating and luteinizing hormones, Vitamin D, parathormone, Tumor Marker: Thyroglobulin, Thyroid antibodies etc.

1.2 Therapeutic Activities

- The therapeutic component of our activity is extensively in the treatment of thyroid cancer and hyperthyroid patients using I-131.
- Strontium-90 for pterygium, corneal neovascularization and squamous cell carcinoma of the conjunctiva.

1.3 Service Rendered (Patients Investigated and Income)

Number of Patients	78,625
Blood Samples Analysis	37,283
[¹⁸ F]FDG Production	90.075 mCi
Total Income in BDT	13,56,03,930
FDG	3,46, 81000

2. Academic Activities

- NINMAS is the only institute in the country where postgraduate degrees on Nuclear Medicine MD residency course has been conducted for medical graduates under Bangabandhu Sheikh Mujib Medical University (BSMMU). In the last academic session, seven (7) residents were admitted for MD course of five (5) years duration. In 2024, two (2) doctors have successfully obtained their post-graduate MD degree.
- Weekly journal review as a continuous education program was conducted on recent Nuclear Medicine & Allied Sciences related works regularly in this institute.
- Scheduled lectures were delivered routine to post-graduate students (MD, MS) of different disciplines of BSMMU, BIRDEM, NIKDU, NICVD, NSH, NICRH, NICDH and Heart Foundation and students are placed for 15-30 days for practical demonstration.
- Collaborator of the 'Multi-Disciplinary Team Approach consultation between oncologists, Head neck surgeons, Pathologists and palliative care units along with Nuclear Medicine specialists of NINMAS for clinical management of complicated and academic cases.

3. Production of Radiopharmaceuticals at Cyclotron Facility

IBA Cyclone 18/9 is a dual particle accelerator/cyclotron whose proton energy is 18 MeV and deuteron energy is 9 MeV. This IBA cyclotron was commissioned in the basement of the F Block at BSMMU campus which is operated by NINMAS, BAEC. The cyclotron is capable to produce positron emitter's radionuclide, namely, ¹⁸F, ¹⁵O, ¹³N, ¹¹C and other isotopes from solid targets for Positron Emission Tomography (PET) imaging. Presently the cyclotron has been exclusively used for the production of ¹⁸F for ¹⁸F-FDG PET imaging. ¹⁸F-FDG is supplied to the NINMAS, INMAS, Dhaka, Combined Military Hospital (CMH), Evercare Hospital Dhaka (EHD), Medinova Medical Services Limited and Institute of Nuclear Medical Physics (INMP), Savar regularly twice a week. The Cyclotron facility is also capable of producing ¹⁸F-NaF, ¹⁸F-FLT and ¹⁸F-MISO.

4. Arranged Training Program/Workshop/Seminar/Symposium/Conference

Sl. No.	Title (Training Program/ Workshop/ Seminar/ Symposium/Conference)	Date	Place	No. of Participants

1.	In-house Training Course on Office Manners as a part of National Integrity Strategy of Bangladesh Government	July 2023- June 2024	NINMAS, Dhaka	277
2.	Weekly Scientific Seminar	July 2023-June 2024	NINMAS, Dhaka	Per week 45
3.	MD Resident's Thesis Protocol Presentation	July 2023-June 2024	NINMAS, Dhaka	50
4.	Scientific program by Radiant Pharmaceuticals Limited	07 May 2024	NINMAS, Dhaka	70

5. Manpower Development(Training/Fellowship/Workshop/Meeting)

Attended in Training/Fellowship/Workshop/Meeting

Sl No.	Name of the Participant	Title of the program	Date	Place	Number of Participants
1.	Sanzida Islam	IAEA- WCI- KAERI E-learning course on Diagnostic and therapeutic radioisotopes and radiopharmaceuticals application with intermediate-level regulation	16-27 Oct. 2023	Virtual Course.	32
2.		International Symposium on Nature for sustainable development.	7-8 Oct. 2023	Bangladesh Science Academy	4
3.		Ovijogh Protikar Beboatha o GRS Software Abong Tothho Adhikar Ayen Bishoyok Proshikkhon	30 March 2024	BAEC, Head Office	-
4.	Dr. Urnas Islam	Statistic Workshop	29 Sep. 2023- 25 Oct. 2023	NINMAS, Dhaka	-
5.		Thyroid Scan	Nov. 2023	NINMAS, Dhaka	-
6.	M. Sohag Mia	In-house Training Course on HPGe Detector	7-9 Nov. 2023	Cyclotron Facilities NINMAS	10
7.		Follow-up training on “Nuclear and Radiological Emergency Preparedness Course”	10-21 Sept. 2023	TI, AERE,	-
8.	Dr. Tapati Mandal	Has Served as an Investigator in the International Atomic Energy Agency Research Project, IAEA Non-Invasive Cardiology Protocol Study- INCAPS 4.	Jan. 2024	Vienna, Austria	-

6. Attended in Seminar/Symposium/Conference/Workshop/Meeting

Name of the Participant	Title of the Event	Organizer	Date	Place
Sanzida Islam	8th Bangladesh International Cancer Congress	Oncology Club	14-15 Sep. 2023	Radison Blu, Dhaka
Dr. F. Begum, F. Begum, Dr. A. K. M. F. Bari, Dr. N. Sultana, Dr. M. A. B. Siddique, M. N. Hossain, Dr. S. Reza, Dr. P. Mutsuddy, Dr. R. Parveen, Dr. T. Mandal, Dr. P. Akhter, Dr. S. N. Bailey, S. Mia, H. Mehdi, S. C. Biswasarma, M. Nur-	6th Annual Conference	BTS	20 Oct. 2023	Pan Pacific Sonargaon Hotel

E Alam Siddiquee, M. S. Islam, S. Islam, Dr. U. Islam.				
Dr. F. Begum, F. Begum, Dr. A. K. M. F. Bari, Dr. N. Sultana, Dr. M. A. B. Siddique, M. N. Hossain, Dr. P. Mutsuddy, Dr. R. Parveen, Dr. T. Mandal, Dr. P. Akhter, Dr. S. N. Bailey, S. Mia, H. Mehdi, S. C. Biswasarma, M. Nur-E Alam Siddiquee, M. S. Islam, S. Islam	27 th National Conference of Society of Nuclear Medicine	SNMB	08 March, 2024	Hotel Intercontinental, Dhaka
Dr. S. Sultana, Dr. F. Begum, F. Begum, Dr. A. K. M. F. Bari, Dr. N. Sultana, Dr. M. A. B. Siddique, Dr. F. Haque, Dr. P. Mutsuddy, Dr. J. Ferdous, Dr. R. Parveen, Dr. T. Mandal, Dr. P. Akhter, Dr. N. F. Ali, Dr. S. N. Bailey, Dr. U. Islam, M. J. Uddin, S. Mia, H. Mehdi, S. C. Biswasarma, M. Nur-E Alam Siddiquee, M. S. Islam, M. Kadir, S. Islam	International Thyroid Awareness Week, Thyroid Diseases are Non-Communicable Diseases (NCDs)	BTS	26 May 2024	NINMAS, Dhaka

7. Stakeholders Meeting

Sl. No.	Title of Event	Date	Place	Number of participants
1.	Published Research Works from Different Divisions of NINMAS Sharing with Stakeholders.	31 Dec. 2023	NINMAS	70

IN-HOUSE Researches

- i. Evaluation of Colorectal Carcinoma by F-18 PET-CT. Dr. Papia Akhter, Dr. Pupree Mutsuddy, Dr. Tapati Mandal, Dr. Md. Abu Bakker Siddique, Dr. S. M. Arifur Rahman, Dr. Sadia Sultana, Dr. Shamim MF Begum & Co-workers.
- ii. Role of F-18 FDG PET-CT in Evaluation of Lung Cancer. Dr. Pupree Mutsuddy, Dr. Papia Akhter, Dr. Tapati Mandal, Dr. Md. Abu Bakker Siddique, Dr. Md. Sajjad Al-Mishal, Dr. Sadia Sultana, Dr. Shamim MF Begum & Co-workers.
- iii. Hormone Receptor Status and Prognosis of Breast Cancer using F-18 FDG PET-CT. Dr. Papia Akhter, Dr. Pupree Mutsuddy, Dr. Tapati Mandal, Dr. Md. Abu Bakker Siddique, Dr. Sadia Sultana, Dr. Shamim MF Begum & Co-workers.
- iv. Correlation of Thyroid uptake in PET-CT with Thyroid Function Test. Dr. Tapati Mandal, Dr. Pupree Mutsuddy, Dr. Papia Akhter, Dr. Md. Abu Bakker Siddique, Dr. Sadia Sultana, Dr. Shamim M. F. Begum & Co-workers.
- v. Evaluation of Myocardial Viability by Cardiac PET. Dr. Tapati Mandal, Dr. Pupree Mutsuddy, Dr. Papia Akhter, Dr. Md. Abu Bakker Siddique, Dr. Sadia Sultana, Dr. Shamim MF Begum & Co-workers.
- vi. Association between Histological types and FDG Uptake in Carcinoma of Stomach. Dr. Md. Abu Bakker Siddique, Dr. Pupree Mutsuddy, Dr. Papia Akhter, , Dr. Tapati Mandal, , Dr. Sadia Sultana, Dr. Shamim M. F. Begum & Co-workers.
- vii. F-18 FDG PET-CT in Evaluation of Prostate Cancer. Dr. Pupree Mutsuddy, Dr. Papia Akhter, Dr. Tapati Mandal, Dr. Md. Abu Bakker Siddique, Dr. Sadia Sultana, Dr. Shamim M. F. Begum & Co-workers.

9. R & D Works

1	Evaluating Internal Exposure Due to Intake of ¹³¹ I At A Nuclear Medicine Centre of Dhaka Using

	Bioassay Methods. F. Begum
2.	Radioactivity Assessment of Radiological Waste ¹³¹ I Applied to The Patients of National Institute of Nuclear Medicine& Allied Sciences (NINMAS). Author's Name: F. Begum
3.	Cause Analysis of [18F] FDG Production Failure at National Institute of Nuclear Medicine and Allied Sciences (NINMAS) and it's Trouble Shooting for Optimizing [18F] FDG synthesis. S. Islam, M. Anwar-Ul Azim, M. J. Uddin, S. C. Biswasarma, M. Saiful Islam, M. S. Mia, H. Mehdi, Nur-E-Alam Siddique, M. Kadir, M. Mamun, S. Khatun, N. Hossain, M. Mamun.
5.	Investigating the Relationship Between total run Time and Pressure on Exit Target port in F18 Production using Medical Cyclotron: A case study of IBA Cyclone 18/9 MeV at NINMAS. Nur-E-Alam Siddique, H. Mehdi, M. M. N. Hossain, M. S. Mia, M. Kadir, Islam, M. S. Islam, M. K. Hossain.
6.	A Comprehensive Analysis of Lymphoscintigraphy Results for Lower Limb Edema in Pediatric Group of Patients at NINMAS. N. F. Ali & Co-workers.
7.	Persistently Low Thyroglobulin (Tg) Level; A Challenging Manifestation in the Management of Metastatic Differentiated Thyroid Carcinoma (DTC). N. Fahmi Ali & Co-workers.
8.	Evaluation and Management of Skeletal Muscle Metastasis in Posterior Chest Wall from Papillary Thyroid Carcinoma. N. F. Ali & Co-workers.
9.	Routine Production of [¹⁸ F]FDG at National Institute of Nuclear Medicine and Allied Sciences (NINMAS): Synthesis and Quality Control Protocols. S. Islam, M. Anwar-Ul- Azim, M. J. Uddin, S. C. Biswasarma, M. S. Islam, Mamun.
10.	Reaction Mechanism Study of ¹⁸ F labeled 2-Fluoro-2-deoxy-D-glucose, [18F] FDG. M. S. Islam, M. Anwar-Ul- Azim, M. J. Uddin, S. Mia, H. Mehdi, Nur -e- Alam Siddique, M. Kadir, N. Hossain, S. Islam, M. Mamun.
11.	Estimating Production yield of F-18 Radioisotope with 18/9 MeV Cyclotron Installed at NINMAS. M. S. Mia, H. Mehdi, Nur -e- Alam Siddique, M. Kadir, M. Anwar-Ul- Azim, M. S. Islam, S. Islam, S. C. Biswasarma, M. J. Uddin, M. N. Hossain, F. Begum.
12.	C-11 Radioisotope Production via the ¹³ N (p, a) C11 Reaction with "Cyclone 18/9 MeV IBA Cyclotron" Installed at NINMAS. M. S. Mia, H. Mehdi, S. C. Biswasarma, M. Anwar-Ul- Azim, M. A. Islam, M. J. Uddin, M. N. Hossain, F. Begum,
13.	Potential of DTPA Renogram in Detection of Renal Anomalies: Experience in NINMAS. S. Reza, S. Sultana, U. Islam, R. Parveen, S. C. Biswasarma, S. Islam
14.	Similarity and Dissimilarity between Myocardial Perfusion Imaging and Dobutamin Stress Echo. S. Reza, N. Sultana, U. Islam, R. Parveen, T. Mandal, S. Alam, F. R. Ananna, S. C. Biswasarma.
15.	Radiological survey from Radioiodine Treated Ca-thyroid Patients for a Hospital Facility and Radioiodine safety Consideration. M. S. Mia, H. Mehdi, Nur E Alam Siddique, M. Kadir, S. C. Biswasarma, M. S. Islam, S. Islam, M. J. Uddin, M. Anwar-Ul-Azim, M. N.Hossain, F. Begum, F. Begum
16.	Minimization of Radiation Hazards for the Technologists Involved in the Oral Administration of I-131 Solution. S. Islam, M. Anwar-Ul-Azim, M. J. Uddin, S. C. Biswasarma, S. Islam, M. S. Mia, Nur E Alam Siddique, H. Mehdi, M. N. Hossain, F. Begum
17.	Perspective of SPECT-CT Hybrid Modality in High Intact Parathyroid Hormone Level - A Single Institute Experience. S. Reza, R. Perveen, T. Begum, N. N. Sayem
18.	Dough Nut Sign Findings of Bone scan- type of carcinoma, Scintigraphic Pattern. S. Reza, R. Perveen, J. Feduos, N. Sultana.
19.	Bone scan finding in neuroblastoma in A tertiary Nuclear medicine Center. R. Perveen, S. Reza
20.	Bone Scan Findings Osteosarcoma in A tertiary Nuclear Medicine Center. S. Reza, R. Perveen, T. Begum, N. N. Sayem
21.	Disseminate Chronic Osteomyelitis in Bone Scan - an Interesting Case Report. S. Reza , R. Perveen, N. Sultana

22.	Bone scan findings osteosarcoma in A tertiary Nuclear medicine Center. S. Reza, R. Perveen, T. Begum, N. N. Sayem.
23.	Disseminate Chronic Osteomyelitis In Bone Scan - an interesting case report. S. Reza , R. Perveen, N. Sultana.
24.	Hypophosphatemic Osteomalasis- An interesting case report. S. Reza , R. Perveen
25.	Comparison of 99m Tc DTPA Renogram With Colour Doppler Study Findings In Prospective Kidney Donor Patients. S. Reza , R. Perveen, J. Ferdous, N. Sultana.
26.	99m Tc Renal Dynamic Imaging for evaluating the Function of Duplex kidneys. S. Reza , R. Perveen, J. Ferdous, N. Sultana.
27.	Similarity and Dissimilarity Between Dobutamin Stress /rest Myocardial Perfusion Imaging and Dobutamin Stress Echocardiography in Case of Known Coronary Artery Disease patients. S. Reza , R. Perveen, N. Sultana, T. Mandal, U. Islam, S. Quddus, S. C. Biswasarma
28.	Potential role of DTPA Renogram in Detection of Renal Anomalies : Experience in NINMAS. S. Reza , S. Quddus, S. Sultana, U. Islam, R. Parveen.

10. Repair & Maintenance, Renovation works

1.	Oversee the QC Programme of Nuclear Medicine Instruments and assisted in repair and maintenance of various equipment. Prof. Ferdoushi Begum, Md. Nahid Hossain and Coworkers.
2.	Took part in the Development and Upgrading of Hot-lab facilities. Prof. Ferdoushi Begum, Md. Nahid Hossain and Coworkers.
3.	Development and Upgrading of Hot-lab facilities of NINMAS; Prof. Ferdoushi Begum, Md. Nahid Hossain and coworkers.
4.	Prepared instrument's present and past status. Prof. Ferdoushi Begum, Md. Nahid Hossain and coworkers.

11. Collaboration work/MOU (ADP/FNCA/MEXT/FTC/IAEA/RCA/TC/S&T/CRP/In-house project, Universities, etc.)

Empowering Regional Collaboration Among Radiotherapy Professionals Through Online Clinical Networks (RCA), IAEA/RCA Project RAS6096 Project NPC: Assoc. Prof. Dr. Sadia Sharmin, Project ANPC: Asst. Prof. Dr. Nabeel Fahmi Ali(2020 to running)

Congenial harmonics established between 28 country counterparts in preparatory meeting of First Virtual Tumor Board.

- First Virtual tumor Board and kick off for ASPRONET (Asia Pacific Radiation Oncology Network).
- ASPRONET Cases shared in online VTB.
- CLP4NET Moodle platform launched with know-hows as a case discussion
- CLP4NET provides academic information setting an online education forum for all experts partaking.
- Global online cooperation established between multinational panel of experts with active discussion on complex clinical scenarios.

12. Oral/Poster Presentation in Seminar/Symposium/Conference(National/International)

National

1.	Dr. Tapati Mandal, Prof. Dr. Shamim Momtaz Ferdousi Begum, Prof. Dr. Nasreen Sultana, Dr. Pupree Mutsuddy, Prof. Dr. Md. Abu Bakkar Siddique, ¹⁸ F-FDG PET Neuroimaging: The initial experience in NINMAS. National Conference of Society of Nuclear Medicine, Bangladesh. SNMB, 8 March, 2024. Hotel Intercontinental, Dhaka.
2.	Dr. Papia Akhter, Prof. Dr. Shamim Momtaz Ferdousi Begum, Prof. Dr. Md. Abu Bakkar Siddique, Dr. Pupree Mutsuddy, Dr. Tapati Mandal, Dr. Md. Sajjad-Al-Mishal, Dr. S. M. Arifur Rahman. Role of ¹⁸ F-FDG PET/CT scan in assessment of recurrence / metastases in female breast carcinoma patients in relation to Human Epidermal Growth Factor Receptor-2. National Conference of Society of Nuclear Medicine, Bangladesh. SNMB, 8 March, 2024. Hotel Intercontinental, Dhaka.
3.	Dr. Rashmi Kar, Dr. Pupree Mutsuddy, Dr. Tapati Mandal, Khokon Kumar Nath, Prof. Dr. Md. Abu Bakkar

	Siddique, Dr. Sadia Sultana, Prof. Dr. Shamim Momtaz Ferdousi Begum. Assessment of agreement between morphologic and metabolic response to platinum based chemotherapy assessed by ^{18}F -FDG PET/CT scan in advanced non-small cell lung cancer. National Conference of Society of Nuclear Medicine, Bangladesh. SNMB, 8 March, 2024. Hotel Intercontinental, Dhaka.
4.	Dr. Tania Sultana, Dr. Tapati Mandal, Dr. Saleha Sultana, Dr. Sumaiya Alam, Dr. Rahima Parveen, Dr. Sharmin Reza, Dr. Urnas Islam. The significance of TID in case of subendocardial ischemia or balanced ischemia in the setting of otherwise normal SPECT myocardial perfusion imaging study. National Conference of Society of Nuclear Medicine, Bangladesh. SNMB, 8 March, 2024. Hotel Intercontinental, Dhaka.
5.	Dr. Jasmin Ferdous, Dr. Shamsun Nahar Bailey, Dr. Urnas Islam, Dr. Simul Sarkar, Dr. Md. Sajjad-Al-Mishal, Prof. Dr. Fatima Begum. Persistency low thyroglobulin (Tg) level; a challenging manifestation in the management of metastatic differentiated thyroid carcinoma (DTC), National Conference of Society of Nuclear Medicine, Bangladesh. SNMB, 8 March, 2024. Hotel Intercontinental, Dhaka.
6.	Dr. Saleha Sultana, Prof. Dr. Zeenat Jabin, Dr. Jasmin Ferdous, Prof. Dr. Fatima Begum. Radioactive iodine therapy responses in children compared to adult population having differentiated thyroid carcinoma with lymph node metastasis. National Conference of Society of Nuclear Medicine, Bangladesh. SNMB, 8 March, 2024. Hotel Intercontinental, Dhaka.
7.	Dr. Pupree Mutsuddy, Dr. Tapati Mandal, Dr. Papia Akhter, Dr. S. M. Arifur Rahman, Prof. Dr. Md. Abu Bakkar Siddique, Mohammad Anwar Ul-Azim, Prof. Dr. Fatima Begum, Prof. Dr. Shamim Momtaz Ferdousi Begum. ^{18}F -PSMA-1007 and ^{18}F -FDG in an advanced prostate cancer-a case report. National Conference of Society of Nuclear Medicine, Bangladesh. SNMB, 8 March, 2024. Hotel Intercontinental, Dhaka.
8.	Dr. Farzana Rahman Ananna, Dr. Tapati Mandal, Dr. Pupree Mutsuddy, Dr. Papia Akhter, Dr. S. M. Arifur Rahman. ^{18}F -FDG PET/CT finding in multiple myeloma with concomitant extrapulmonary tuberculosis: a rare case report. National Conference of Society of Nuclear Medicine, Bangladesh. SNMB, 8 March, 2024. Hotel Intercontinental, Dhaka.
9.	Sanzida Islam, Mohammad Anwar Ul-Azim, Md. Jasim Uddin, Sanchoy Chandra Biswasarma, Md. Saiful Islam, Md. Shohag Mia, Md. Hasan Mehedi, Md. Nur-E-Alam Siddiquee, Md. Muhtasim Kadir, Md. Mostafa Mamun, Sakera Khatun, Md. Nahid Hossain, Prof. Ferdousi Begum. Cause analysis of [^{18}F]FDG production failure at National Institute of Nuclear Medicine & Allied Sciences (NINMAS) and it's trouble shooting for optimizing [^{18}F]FDG synthesis. National Conference of Society of Nuclear Medicine, Bangladesh. SNMB, 8 March, 2024. Hotel Intercontinental, Dhaka.
10.	Md. Nur-E-Alam Siddiquee, Md. Hasan Mehedi, Md. Nahid Hossain, Md. Shohag Mia, Md. Muhtasim Kadir, Sanzida Islam, Md. Saiful Islam. Investigating the relationship between total run time and pressure on exit target port in F-18 production using medical cyclotron 18/9 MeV at NINMAS. National Conference of Society of Nuclear Medicine, Bangladesh. SNMB, 8 March, 2024. Hotel Intercontinental, Dhaka.
11.	Sanjida Islam, Mohammad Anwar-Ul Azim, Ferdoushi Begum, Md. Jashim Uddin, Sanchoy Chandra Biswasarma, Md. Saiful Islam. Minimization of Radiation Hazards for the Technologists Involved in the oral Administration of I-131 Solution. National Conference and Annual General Meeting, BTS, 20 October 2023.
12.	Dr. Sharmin Reza. Thyrotoxic Periodic Paralysis Medical Emergency, Mimicking to Neurological Symptoms. National Conference and Annual General Meeting, BTS, 20 October 2023.

13. Others

1.	Organized laboratory for routine clinical Facilities works as well as R&D
2.	Ensure radiation safety for the patients, attendances and radiation workers.
3.	Regular supervision of the radiation workers as to ensure safe usages of radioactive materials and continuous training of radioactive material handling.
4.	Supervision on radiation workers to ensure the proper usages of TLD badges, if need, then provide and also maintain the data of absorbed doses of the radiation workers.
5.	Conduct regularly radioactive waste management activities.
6.	Preparation of radiation safety protocols, such as, radiation waste management, emergency preparedness protocol, etc.
7.	Conduct all works related to the licensing of the institute to handle safe use of radioactive material and radiation safety.
8.	Supervised all routine Nuclear Medicine Procedures at NINMAS, Dhaka.
9.	Lecture on Electron Energy Level & Nuclear Energy Level, MD Residency (Nuclear Medicine) Phase-A, Block-1 & 2
10.	Practical-1 QC of Dual Head Gamma Camera, MD Residency (Nuclear Medicine) Phase-B, Block-3
11.	Practical-2 QC of Dual Head Gamma Camera, MD Residency (Nuclear Medicine) Phase-B, Block-3

INSTITUTE OF NUCLEAR MEDICINE AND ALLIED SCIENCES (INMAS), DHAKA**Objectives**

Institute of Nuclear Medicine & Allied Sciences is one of the oldest Nuclear Medicine in this country and it was established in 1961 in the Dhaka Medical College premises. At present this institute included different technologies like PET-CT, SPECT-CT, Dual headed Gamma Camera, BMD, thyroid scanner, 3D & 4D ultrasound and well equipped RIA and CLIA facilities. Significant number of patient's health care services are offered from this institute as regular basis. Our objectives to render specialized medical services by using nuclear technology and also conduct academic & research activities.

Programme(s)

1. Manpower Development**(Training program/Workshop/Seminar/Symposium/Conference)**

Sl. No.	Title (Training program/ Workshop/ Seminar/ Symposium/Conference)	Date	Place	No. of Participant
a)	Monthly Seminar	Every Tuesday	INMAS, Dhaka	150
b)	Learning Sessions for Capacity building of employees on current affairs.	5 December 2023	INMAS, Dhaka	11

2. Attended in Seminar/ Symposium/Conference/ Workshop/Meeting

Name of the Participant	Title of the event	Organizer	Date	Place
Dr. Jasmine Ara Haque Dr. Shankar Biswas Dr. Rubina Begum Dr. Farhana Rahman Dr. Rawnak Afrin Dr. Mohana Hossain Dr. Sadia Hossain Dr. Afroza Akhter Dr. Tania Sultana Dr. Tamina Biswas Dr. Shaila Sharmin Dr. Sabrina Islam Bodrul Hasan Mamun Shahida Khatun Md. Abul Hasan Kamal Uddin Habibur Rahman Serker Abdul Awal Khan	27 th National conference of SNMB	Society of Nuclear Medicine, Bangladesh (SNMB)	8 March 2023	Bangladesh
Dr. Rawnak Afrin	3 rd International Scientific Conference on Musculoskeletal Imaging	Sheikh Hasina National Institute of Burn and Plastic Surgery	21 September 2023	Bangladesh
Dr. Afroza Akhter	Future Leaders: The Next Generation of Nuclear Cardiology	American Society of Nuclear Cardiology	28 September 2023	Toronto, Canada
Dr. Shankar Biswas Dr. Afroza Akhter	ASNC 2023	American Society of Nuclear Cardiology	29 September to 01 October 2023	Toronto, Canada
Dr. Jasmine Ara Haque Dr. Shaila Sharmin	15 th Oceania Congress of Nuclear Medicine & Biology	AOCNMB	5-7 October 2023	Amman, Jordan

Dr. Jasmine Ara Haque Dr. Shankar Biswas Dr. Rubina Begum Dr. Farhana Rahman Dr. Rawnak Afrin Dr. Mohana Hossain Dr. Sadia Hossain Dr. Afroza Akhter Dr. Tania Sultana Dr. Shaila Sharmin Dr. Sabrina Islam	35 th National conference of BSU	Bangladesh Society of Ultrasonography	27-28 October, 2023	Bangladesh
Dr. Shankar Biswas Dr. Afroza Akhter	Bangla Cardio 2023 Conference	Bangladesh Cardio Society	15-17 November 2023	Bangladesh
Dr. Mohana Hossain	Project on Supporting the adoption Electron Beam Technology and its Application in Area of Food and Agriculture, Industry, Human Health and Environment Treatment	Korea Atomic Energy Research Institute	12-15 December 2023	Bangkok, Thailand
Dr. Shankar Biswas	First Coordination Meeting TC	IAEA	09-17 February 2024	Austria Vienna
Dr. Rawnak Afrin	17 th Biennial National Convention & Scientific Seminar	Bangladesh Society of Radiology & Imaging	15-17 February 2024	Bangladesh
Dr. Afroza Akhter	PHA Global Summit 2024	Planetary Health Academy	24-25 February 2024	Bangladesh
Dr. Rawnak Afrin Dr. Afroza Akhter Dr. Shaila Sharmin	ECR 2024	European Society of Radiology	28 February to 03 March 2024	(Online) Vienna, Austria
Dr. Farhana Rahman	Clinical Training of Dual Head SPECT Scanner With Accessories Mediso Medical Imaging System Ltd		17-31 March 2024	Hungary
Dr. Shankar Biswas Dr. Rawnak Afrin Dr. Afroza Akhter Dr. Tania Sultana	BCSIR Congress-2023	BCSIR	8-10 March 2024	Bangladesh
Dr. Shankar Biswas Dr. Afroza Akhter	Bangladesh Live Cardiovascular Conference	IPDI Foundation, Bangladesh	1-2 May 2024	Bangladesh

3. Collaboration Work/MoU (ADP/FNCA/MEXT/FTC/IAEA/RCA/TC/S&T/CRP/In-house project/ Universities, etc

Title: Enhance Capacity of Institute of Nuclear Medicine & Allied Sciences, Dhaka

Project Director: Md. Zahangir Alom, Chief Engineer, BAEC, Dhaka.

Renovation/Modification works of the existing building including false ceiling, plaster, RCC Works, floor tiles, wall tiles, plastic paint, distemper, weather coat, door, chowkat change, grill, sliding window, vantian blind etc. including electrical & electromechanical works.

4. Academic Activities:

Taken classes to medical students (under & post-graduates) and trainees, Given demonstrations to medical students (under & post-graduates) and trainees, Attended scientific seminars & workshops, Helped in student co-ordination.

5. Service Rendered

Sl. No.	Name of Service Provided	Number/Quantity of Sample/Patient/Service	Income (If any)
a.	Patient Service		
b.	Sample analysis (including blood sample) Regular Patient Service	53265	6, 47, 95, 993
c.	NDT Service (Person & organization)	X	X
	Food/Medical Products Irradiation	X	X
Total=			6, 47, 95, 993

INSTITUTE OF NUCLEAR MEDICINE AND ALLIED SCIENCES (INMAS), MITFORD

Objective

- Application of Nuclear technology in Medical services
- To improve and upgrade nuclear medicine facilities in Bangladesh.
- To conduct academic and research activities.

1. R&D work(s)

1.1 High Resolution Color Doppler Ultrasound Evaluation of Swelling and Mass Lesions of the Superficial Part of the Body – Single Institute Experience at INMAS, Mitford

Samira Sharmin, Hosne Ara Rahman, Mohammad Baqui Billah, Farida Yasmin, Afroza Naznin, Jerin Sultana, Humayra Tasnim, Arshad Hossain, Md. Monir Uddin

HRUS is the primary tool for the evaluation of superficial mass, swelling or lesion. A careful ultrasonic evaluation enables the examiner to analyze multitudes of differential diagnosis for various diseases at remarkably low cost and in a non-invasive, radiation-hazard free available method that can be used along with physical examination for management of many superficial lesion.

1.2 Association of Gestational Age with Unconventional Sonographic Parameters including Fetal Ocular Biometry and Renal Length

Afroza Naznin, Arshad Hossain, Jerin Sultana, Humayra Tasnim, Farida Yasmin, Samira Sharmin, Mohammad Simoon Salekin, Hosne Ara Rahman

Determination of accurate gestational age is of paramount importance in obstetric practice. Besides the traditional parameters less conventional fetal biometric parameters can help to prudently determine gestational age with Pearson correlation co-efficient being more than 0.9.

1.3 The impact of smoking on thyroid gland volume, echotexture, nodularity and function: Initial experience at INMAS, Mitford

Farida Yasmin, Afroza Naznin, , Samira Sharmin, Hosne Ara Rahman

Smoking enhances diffuse enlargement of thyroid gland. This study found moderately positive correlation between smoking habit and thyroid gland volume ($rs=0.494, p < 0.01$) and smoking duration and thyroid gland volume ($rs = 0.478, p < 0.01$). No significant correlation was found between smoking habits and thyroid echotexture, nodularity and function.

1.4 Menopausal Age of Differentiated Thyroid Carcinoma Patients after Single Dose of Radioiodine Therapy- Single Institute Based Experience

Samira Sharmin, Syed Md. Baqui Billah, Hosne Ara Rahman, Afroza Naznin, Farida Yasmin, Md. Monir Uddin

Menopause is a natural & unavoidable circumstance in women's life and radioiodine therapy is a popular method of treatment for DTC. Considering these two this small scale study result showed the mean age of menopause was 45.6 ± 2.2 among the group taking 75 mCi ^{131}I , 44.4 ± 2.7 among the group taking 100 mCi and 44.1 ± 2.0 among the group taking 150 mCi. The result was significant ($P < 0.05$)

1.5 Exploring Neuropsychiatric Symptom in Post-Therapy Thyroid Disorder Patient: Anxiety Level Assessment

Afroza Naznin, Farida Yasmin, Samira Sharmin, Hosne Ara Rahman

Thyroid disorder patient not only facing cognitive impairment symptoms but also some neuropsychiatric symptoms like anxiety. A structured questionnaire(Hamilton Anxiety rating scale) was used for scoring. The mean HAM-A score in the hyperthyroidism group was 9.5 whereas, in thyroid carcinoma group 8.4.

It was not statistically significant. So, post-therapy thyroid disorder patients experiences a low level of anxiety symptoms which is unrelated to their initial diagnosis and biochemical thyroid status.

1.6 Post Ablative Hypothyroidism in Hyperthyroid Patients : Single Institute Based Observational Study

Farida Yasmin, Afroza Naznin, Samira Sharmin, Hosne Ara Rahman

The incidence of post-ablative hypothyroidism within six months was 55.45 %. Among them, 1.59 % became hypothyroid at 1st month, 26.98 % became hypothyroid after six months. Therefore as we know RAI therapy is a popular & effective therapeutic modality for treatment of hyperthyroidism & majority of patients became hypothyroid within a short period of time so regular follow up is needed to monitor the patient biochemical status.

2. Manpower Development (Training/Fellowship/Workshop/Meeting)

2.1 Attend in training/fellowship/workshop/meeting

Sl. No	Title of Event	Date	Place	No of participant
a)	“২০২৩-২৪ অর্থ বছরের বার্ষিক এপিএ সুচক” সমসাময়িক বিষয়ে কর্মচারীদের সক্ষমতা উন্নয়নে লনিং সেশন	4th Sept, 2023	BAEC Dhaka	2
b)	“বপশক-এর কর্মকর্তা /কর্মচারীদের PL-A/C ও iBAS++ বিষয়ক প্রশিক্ষণ	7th-8th Oct. 2023	BAEC Dhaka	2
c)	Digital sign/ E-sign বিষয়ক প্রশিক্ষণ	19th Dec, 2023	BAEC Dhaka	1
d)	Training on RIT, GRS and NIS-ACR	21st Dec, 2023	BAEC Dhaka	1
e)	Training course on PPR-2008 and PPR-2004	28th Jan-8th Feb 2023	AERE Savar	1
f)	Workshop on pregnancy Doppler	28th October 2023	Dhaka	2
g)	30 WFUMB Center of Education Workshop 20 AFSUMB Workshop	1-2nd March 2024	Dhaka	4
h)	SAMSUNG Experience Day 2024	17th February 2024	Dhaka	3
i)	3 rd International Master Class on Interventional USG	18-19th February 2024	Dhaka	1
a)	PHA breast biopsy workshop	26-27th Feb 2024	BSMMU Dhaka	1
b)	2 nd exclusive workshop and hands on training on fetal echocardiography	27-28th April 2024	Dhaka	1
l)	“General behaviour & office rules”- চাকুরীর আচরণ বিধি ও নিয়ম-শৃঙ্খলা সংক্রান্ত প্রশিক্ষণ	5th-7th March 2024	BAEC Dhaka	1
m)	“তথ্য অধিকার, অভিযোগ প্রতিকার ব্যবস্থা ও জিআরএস সফটওয়্যার বিষয়ক প্রশিক্ষণ	30th April 2024	BAEC Dhaka	1

n)	AwMæ wbivcĖv m‡PZbvi j‡Ź nv‡Z-Kj‡g cÖwkÿb	10th Jan 2024	INMAS Mitford	6
o)	Ź©vU evsjv‡`k wewbg©v‡Y D™Źvebv avibv	24th June 2024	BAEC Dhaka	1

3. Organize training /fellowship/ workshop/ meeting

Sl. No	Title of the program	Date	Place	Number of participants
	CME of SSMCH	2nd October 2023	SSMCH Surgery Seminar Room	27

4. Oral/Poster Presentation in Seminar/Symposium/Conference(National and International)

Name of the Participant	Title of oral/poster presentation	Title of the event	Organizer	Date	Place
Dr.Samira Sharmin	Klippel-Trenaunay Syndrome: A Case Report	35th National Conference of Bangladesh Society of Ultrasonography.	BSU	27th october2023	Dhaka
Dr. Afroza Naznin	Application of Quantitative Shear Wave Elastography in Evaluating Uterine Fibroid and Adenomyosis: An Initial Experience	35th National Conference of Bangladesh Society of Ultrasonography	BSU	27th october2023	Dhaka
Dr. Farida Yasmin	A Case Report on Epigastric Heteropagus Twin: Autosite with Multiple Congenital Heart Diseases	35th National Conference of Bangladesh Society of Ultrasonography	BSU	27th october2023	Dhaka
Dr. Afroza Naznin	Exploring the Potential of Body Composition Change in Pre- and Post- Ablation State of Thyroid Carcinoma Patients	15th Asia Oceania Congress of Nuclear Medicine and Biology & the 4th Annual Conference of the Jordanian Society of Nuclear Medicine.	AOCNM B	5-7 th October 2023	Jordan
Dr. Afroza Naznin	Anxiety Level Assessment in Post-therapy Thyroid Disorder Patients: Searching for Residual Persistent Neuropsychiatric Symptom	6th National Conference of Bangladesh Thyroid Society.	BTS	20 th October 2023	Dhaka
Dr. Samira Sharmin	Bone scan features of carcinoma breast patients before surgery and correlation with other imaging modality- Single instate based observational study	27th National Conference of Society of Nuclear Medicine Bangladesh	SNMB	8 th March	Dhaka
Dr. Afroza Naznin	Observing the trend of body composition change in pre & post ablation state of thyroid carcinoma patient	27th National Conference of Society of Nuclear Medicine Bangladesh	SNMB	8 th March	Dhaka
Dr. Afroza Naznin	Successful Application of Radio-iodine Ablation	BCSIR Congress	BCSIR	9 th March	Dhaka

	Therapy in a Rare Case of Dual Thyroid Malignancy				
Dr. Samira Sharmin	Menopausal age of differentiated thyroid carcinoma patients after radioiodine therapy- Single institute based experience INMAS, Mitford , Dhaka	International Conference on Physics-2014		9-11 th May 2024	Dhaka
Dr. Afroza Naznin	Exploring the potential of Quantitative Shear Wave Elastography in evaluating two uterine pathologies through trans-vaginal ultrasound	International Conference on Physics-2014		9-11 th May 2024	Dhaka
Dr. Farida Yasmin	Study of fetus safety by observing mechanical & thermal indices and scan duration while operating ultrasound machine for pregnancy scanning at INMAS, Mitford: Practicing Alara Principle	International Conference on Physics-2014		9-11 th May 2024	Dhaka

4. Stakeholder Meeting

Sl. No	Title of the program	Date	Place	Number of participants
	জাতীয় শুদ্ধাচার কৌশল কর্ম পরিকল্পনা ২০২২-২৩ এর সূচক মোতাবেক গণশুনানী আয়োজন ও সেবা গ্রহীতাদের অভিযোগ বিষয়ে Stakeholder মত বিনিময় সভা (one meeting in each quarter)	9/06/2024 21/03/2024 20/12/2023 20/08/2023	INMAS, MITFORD	20 26 26 24

5. Academic Activities

- Scheduled Lectures were delivered to M.Phil/ MD/ MS students of different discipline of SSMCH, Mitford.
- Scheduled Lectures were delivered to MD (Nuclear Medicine) students .
- Monthly in-house meeting and Seminar is held regularly

6. Service Rendered

Sl no.	Name of service provided	number/quantity of sample/patient / service	revenue income (if any)
	a) Scintigraphy service	726	
	b) Blood sample analysis	11134	
	c) I 131 Therapy	79	
	d) USG and others	15012	
		Total – 26,951	Total : 1,72,79,150

7. Repair & Maintenance, Renovation works, etc.

Project “ Enhance capacity of Institute of Nuclear Medicine and allied Sciences (INMAS) at Mitford, Cumilla, Faridpur, Barishal and Bogura” is going on.

Description: Renovation/ Modification/ Beautification works of the existing building and reception counter including all necessary civil, sanitary, mechanical and electrical works at INMAS, Mitford.

Installation of modern equipments like PET/ CT, SPECT/CT, Dual head SPECT , CLIA, RIA counter.

INSTITUTE OF NUCLEAR MEDICINE AND ALLIED SCIENCES (INMAS), CHATTOGRAM

Objective

Main objectives of the institute are

- To perform nuclear medicine diagnostic services
- To provide nuclear medicine therapeutic services
- To accomplish academic and training activities
- To conduct research and development (R&D) works.

Future objectives of the institute are

- Enhancement of the diagnostic & therapeutic capabilities, comprising expansion of infrastructure, equipment & manpower etc.
- Further expansion of the scopes of academic, research& development activities and development of skilled human resources.

1. R&D work(s)

1.1 Analysis of Bone Mineral Density (BMD) and Associated Risk Factors: A Single Center Study

Pabitra Kumar Bhattacharjee, Mahjabin Nobil Khan, Muhammad Farhan Muhtasim, Noor-E-Amrin Alim, Mohammad Sazzad Hossain, Abdullah Al Persi, Md. Ajijul Hoq, Anjuman Ara Akhter

This retrospective study included a cohort of 628 individuals seeking bone mineral density (BMD) assessments using Dual Energy X-ray Absorptiometry (DEXA or DXA). Correlation among BMD and five contributing factors (age, gender, origin, parity of the female participants and pre-existing clinical conditions i.e. hypertension, diabetes) were studied.

This study included 84% female and 16% male participants. The mean BMD was found significantly lesser in older participants (aged >50 years) ($p=.000^{**}$ for both sites of lumbar spine (LS) and femoral neck (FN)). It also varied significantly in both skeletal sites, depending on the gender ($p=.000^{**}$ and $p=.027^{**}$ respectively). Rural participants were found with lower BMD than urban one ($p=.000^{**}$ and $p=.037^{**}$ respectively). Interestingly, diabetic participants were found to have higher bone density in this study ($p=.002^{**}$ and $p=.000^{**}$ respectively). BMDs of LS and FN were found to have significant negative correlations with age ($-.201^{**}$ and $-.280^{**}$) and parity ($-.317^{**}$ and $-.236^{**}$). A significant decrease in mean BMD was also found in multiparous (parity >2) female compared to normal (parity <2) and nulliparous female ($.000^{**}$ and $.048^{*}$ respectively for LS and FN). This proactive approach to prevent osteoporosis in study population involves a meticulous investigation of its etiological factors and addressing them precedently. **Description:** This retrospective study included a cohort of 628 individuals seeking bone mineral density (BMD) assessments using Dual Energy X-ray Absorptiometry (DEXA or DXA). Correlation among BMD and five contributing factors (age, gender, origin, parity of the female participants and pre-existing clinical conditions i.e. hypertension, diabetes) were studied.

This study included 84% female and 16% male participants. The mean BMD was found significantly lesser in older participants (aged >50 years) ($p=.000^{**}$ for both sites of lumbar spine (LS) and femoral neck (FN)). It also varied significantly in both skeletal sites, depending on the gender ($p=.000^{**}$ and $p=.027^{**}$ respectively). Rural participants were found with lower BMD than urban one ($p=.000^{**}$ and $p=.037^{**}$ respectively). Interestingly, diabetic participants were found to have higher bone density in this study ($p=.002^{**}$ and $p=.000^{**}$ respectively). BMDs of LS and FN were found to have significant negative correlations with age ($-.201^{**}$ and $-.280^{**}$) and parity ($-.317^{**}$ and $-.236^{**}$). A significant decrease in mean BMD was also found in multiparous (parity >2) female compared to normal (parity <2) and nulliparous female ($.000^{**}$ and $.048^{*}$ respectively for LS and FN). This proactive approach to prevent osteoporosis in study population involves a meticulous investigation of its etiological factors and addressing them precedently.

1.2 Incidental Detection of Thoracic Ectopic Kidney with Bochdalek Hernia-A Case Report

Noor-e Amrin Alim, Muhammad Farhan Muhtasim, Abdullah Al Persi, Mahjabin Nobi Khan, Mohammad Sazzad Hossain, Anjuman Ara Akhter, Pabitra Kumar Bhattacharjee

Bochdalek hernia is a congenital defect in the diaphragm that allows abdominal organs to move into the chest cavity. It is the most common type of congenital diaphragmatic hernia, occurring in about 1 in 2,200 to 12,500 live births, predominantly affecting the left side of the thorax. This condition usually involves a normal diaphragm and is associated with various other abnormalities. Intra-thoracic kidney, a rare form of renal ectopia, occurs in less than 0.25% of congenital diaphragmatic hernia cases. It is most often found incidentally because it usually presents without symptoms. Herein we report a case of a 25-year-old male who was referred for renal scintigraphy due to an unvisualized left kidney on ultrasound. A DTPA renogram indicated an unusually high position of the left kidney, which was later confirmed as Bochdalek hernia with intra-thoracic kidney through a CT scan.

1.3 An approach of radiological impact analysis due to a simulated accident of the TRIGA research reactor of Bangladesh

M. Abu Khaer, M. Ajijul Hoq, S.M.T. Hassan, M.T. Chowdhury and M.M. Rahman

The present study focused on the radiological impact analysis by assessing radiological doses due to a postulated TRIGA Mark-II research reactor accident at AERE, Savar, Dhaka, Bangladesh. Core inventory and source term of radionuclides from different groups such as noble gas, halogen, tellurium, alkali metal, lanthanide, alkaline earth metal, cerium and transition metal were analyzed for 365 days of operation at full power (3 MWth) due to a postulated nuclear accident. The HotSpot code was used for the dose calculation, and the dose values of TED, and Thyroid were calculated for a 40 km radius from the reactor site. Local meteorological data from Bangladesh Meteorological Department were used for the dose assessment and doses were calculated in the three dominant directions such as South, Southeast, and West. The TED and Thyroid dose values are assessed and compared to the PAZs dose criteria of the U.S. Environmental Protection Agency. It is found that doses are higher in stability class F, and evacuation, sheltering, and iodine prophylaxis are needed at longer distances. Since outside of the AERE campus is densely populated, these calculated data may help to ensure radiological safety by taking required protective actions like evacuation, sheltering, and iodine tablet consumption for the same type of accidental situation.

1.4 Assessment of radiation dose associated with the atmospheric release of ^{41}Ar from the TRIGA Mark-II research reactor in Bangladesh

M. Ajijul Hoq, M.A. Malek Soner, S. Khanom, M.J. Uddin, M. Moniruzzaman, M.S.H. Chowdhury, A. Helal, M. Abu Khaer, S.M.T. Hassan, M. Tareque Chowdhury, M. Mizanur Rahman

The research work was concentrated on the detail radiological dose assessment resulting from the atmospheric release of ^{41}Ar activity from the TRIGA Mark-II research reactor in Bangladesh during its normal operational condition at full power of 3 MW. The total effective dose equivalent (TEDE), Ground deposition activity, organ committed dose, and pathways dose values have been evaluated under different weather conditions using the HotSpot 3.1.2 code. The weather data has been gathered from the Bangladesh Meteorological Department (BMD), Dhaka. Two significant seasons with various weather stability effects have been considered for dose analysis. Atmospheric dispersion of ^{41}Ar was evaluated using the Gaussian plume model. From the obtained results, the maximum TEDE of 4.06×10^{-9} Sv at 0.19 km distance from the reactor site for stability class B during the summer season is found to be well below the annual effective dose limit of 1 mSv recommended by the ICRP. During the rainy season, the maximum TEDE of 1.76×10^{-9} Sv at 0.92 km distance for stability class E is also found to be negligible compared to the dose limit. From the organ committed dose analysis, skin is investigated as the highest dose absorber compared to other organs. The pathways dose analysis concludes that the submersion and ground shine doses are observed to be maximum at 0.20 km and 1.0 km distances for the summer and rainy seasons, respectively. Based on the identified results, dose values have been found to be within the limiting values, ensuring environmental and human health safety. Such comprehensive dose analysis due to the atmospheric release of ^{41}Ar activity is very significant

from the perspective of ensuring the radiological and environmental safety of research-type nuclear reactors under normal operational conditions.

1.5 Osteoporosis in an Adolescent Female: A Case Report

Abdullah Al Persi, Muhammad Farhan Muhtasim, Noor-e Amrin Alim, Mohammad Sazzad Hossain, Anjuman Ara Akhter, Pabitra Kumar Bhattacharjee

Osteoporosis constitutes a significant disease burden globally. While this disease has been historically associated with postmenopausal women and elderly men, osteoporosis in younger adults does occur in the setting of chronic disease, medications that affect bone metabolism, and other risk factors. Among those, glucocorticoids are an important risk factor for bone fragility in children or young adults with serious illnesses, largely due to their direct adverse effects on skeletal metabolism. In this report, we present a case of a 16-year-old female diagnosed with glucocorticoid-induced osteoporosis (GIO). She had been on prednisolone for more than a year owing to progressive glomerulonephritis with a nephrotic picture. She developed severe low back pain and restricted mobility and sought urgent care. Spine radiographs showed osteoporotic changes, which warranted further investigations including bone mineral densitometry (BMD) by dualenergy x-ray absorptiometry (DXA). BMD revealed a T-score and Z-score of -3.1 at lumbar spine, suggestive of osteoporosis. In light of her medical history and the BMD findings along with a low basal cortisol level, a diagnosis of glucocorticoid-induced osteoporosis (GIO) was made. She was commenced on Teriparatide, a recombinant human parathyroid hormone analog and subsequently discharged upon regaining ambulation.

1.6 Analysis of Biochemical, Hematological status and *gadd45a* gene expression to observe the Effects of Occupational Exposure to Low Dose Ionizing Radiation

Mahjabin Nobi Khan, Mohabbat Hossain, MD Shafiqul Islam Rakib, Muhammad Farhan Muhtasim, Abdullah Al Persi, Md. Ajijul Hoq, Noor-E-Amrin Alim, Mohammad Sazzad Hossain, Anjuman Ara Akhter, Nazneen Naher Islam, Pabitra Kumar Bhattacharjee

In this observational study, biochemical (serum concentration of alanine aminotransferase (ALT), alkaline phosphatase (ALP) and creatinine), hematological (complete blood cells (CBC) count) and genetic study (relative gene expression analysis of growth arrest and DNA damage inducible alpha; *gadd45a*) were done using blood samples of radiation workers of a nuclear medicine institute. However, the mean differences were not significant ($p>0.05$) but the biochemical analysis showed that the serum levels of ALT (mean difference: 8.3), ALP (mean difference: 3.5) were higher and conversely, creatinine was lower (mean difference: 0.04) in case than control. From the hematological analysis, the white blood cells (WBC) (mean difference: $.48 \times 10^9/L$, $p>0.05$) and platelets (mean difference: $4.4 \times 10^9/L$, $p>0.05$) count were found higher in case population than control but in case of red blood cells (RBC) the result was opposite (mean difference: .09 mi/cumm, $p>0.05$). While analyzing the impact of daily exposure of low dose IR (hours), serum level of ALT, creatinine and RBC count showed positive correlation (Pearson's correlation coefficients are .330, .234 and .245 respectively; $p>0.05$), whereas the serum level of ALP, WBC and platelet count showed negative correlation (Pearson's correlation coefficients are -.428, -.064 and -.135 respectively; $p>0.05$). In case population creatinine was found significantly higher in male than female (a mean difference of .19 (95% CI, .04 to .34) gm/cm², $t(15)= 2.652$, $p=.02^*$). The relative expression of the *gadd45a* gene was found 1.44-fold up-regulated on average in the suspected samples in comparison with the healthy control samples which is statistically significant ($p=0.0029^{**}$). Despite no significant changes in biochemical and hematological parameters, genetic analysis revealed a notable upregulation of a DNA damage inducible gene, warranting further research on genetic biomarkers for detecting the impact of chronic exposure to low dose IR.

1.7 Immunotherapy in Radioactive Iodine Refractory Thyroid Cancer – Case Report and Review of Literature

Muhammad Farhan Muhtasim, Abdullah Al Persi, Mahjabin Nobi Khan, Noor-e-Amrin Alim, Mohammad Sazzad Hossain, Anjuman Ara Akhter, Pabitra Kumar Bhattacharjee

Recent advancements in treating radioiodine-refractory advanced differentiated thyroid cancer (DTC) have significantly changed its management. Although DTC generally has a good prognosis, about 15.25% of cases

do not respond to standard treatments. New therapies, including immune checkpoint blockers and multi-kinase inhibitors like Lenvatinib and Cabozantinib, have been approved, but they are not curative and often lead to disease progression. Current research is focused on understanding the mechanisms of resistance. A case report highlights a patient with radioiodine-refractory advanced DTC who, after conventional treatment, was treated with Lenvatinib and Cabozantinib, with prognosis assessed through biochemical, genetic, and clinical evaluations.

1.8 Investigating Unexpected Shortening of Height of a Middle-Aged Woman: A Case Report

Author's name: Muhamamd Farhan Muhtasim, Abdullah Al Persi, Mahjabin Nobi Khan, Noor-E-Amrin Alim, Md. Sazzad Hossain, Pabitra Kumar Bhattacharjee

Osteitis fibrosa cystica (OFC) results from untreated hyperparathyroidism, leading to bone pain, deformities, and fractures due to excess parathyroid hormone (PTH). We report a middle-aged woman who experienced gradual height loss, weight loss, and widespread pain over a decade. Initial treatments with analgesics and steroids, as well as interventions for suspected tuberculosis, were ineffective. She developed lytic bone changes and osteoporosis, and was eventually diagnosed with a solitary right parathyroid adenoma.

2. Manpower Development (Training /Fellowship/ Workshop/Meeting)

2.1 Attend in Training /Fellowship/ Workshop/Meeting

Sl. No	Title of the program	Date	Place	Number of participants
01	Training Course on Radiation Protection for Radiation Workers and RCO's of BAEC, Medical Facilities & Industries	02-06-2024 to 06-06-2024	Training Institute, Saver, Dhaka	01
02	Fundamental Training Course (Grade: 13-16)	26-05-2024 to 13-06-2024	RPATC, Chattogram	01
03	D-Nothi Course (Grade: 13-16)	12-05-2024 to 16-05-2024	RPATC, Chattogram	01
04	Election Manifesto, 2024	07-05-2024	RPATC, Chattogram	01
05	Information & Communication Technology (ICT) Course (Grade: 13-16)	28-04-2024 to 09-05-2024	RPATC, Chattogram	01
06	Grievance Redressal Mechanism and GRS Software" and "Right to Information Act"	30-04-2024	Online Platform	01
07	Training on Treadmill ergo meter	05-11-2023 to 09-11-2024	NINMAS, Dhaka	02
08	Environmental Radioactivity Monitoring Course	29-10-2023 to 02-11-2023	Training Institute, Saver, Dhaka	01
09	Training on PL A/C and iBAS++	07-10-2023 to 08-10-2023	Institute of Public Finance, Dhaka	01
10	Radiological Emergency Preparedness Course	10-09-2023 to 21-09-2023	Training Institute, Saver, Dhaka	01

3. Organize Training /Fellowship/Workshop /Meeting

Sl. No	Title of the program	Date	Place	Number of participants
01	Recent updates on iBAS++ (Rules and Regulations)	25-06-2024	INMAS, Chattogram	20
02	Hepatobiliary Ultrasound	11-06-2024	INMAS, Chattogram	08
03	Research Methodology and publication procedure	04-06-2024	INMAS, Chattogram	05
04	The AIUM Practice Parameter for the	28-05-2024	INMAS,	08

	performance of an Ultrasound Examination of the Abdomen and/or Retroperitoneum		Chattogram	
05	Types, Reasons and Duration of Government Leave	21-05-2024	INMAS, Chattogram	27
06	SNMMI/ EANM Guidelines: Renogram of Adult Patients	14-05-2024	INMAS, Chattogram	15
07	EANM Practice Guidelines for Parathyroid Imaging	07-05-2024	INMAS, Chattogram	08
08	Basic Principles of CT Scan & its clinical application	30-04-2024	INMAS, Chattogram	06
09	Biochemical, Hematological & Genetic Study of the Effects of Occupational Exposure to Low Dose Ionizing Radiation	23-04-2024	INMAS, Chattogram	29
10	SNMMI/EANM Guidelines: adult renogram	05-03-2024	INMAS, Chattogram	05
11	iBAS++ Rules and Regulations	27-02-2024	INMAS, Chattogram	19
12	Pitfalls in 1-131 WBS : Interpretation False Positive in Context	20-02-2024	INMAS, Chattogram	07
13	Calcium Management	13-02-2024	INMAS, Chattogram	27
14	Anomaly Scan	30-01-2024	INMAS, Chattogram	06
15	General Administrative Procedures & BAEC Service rules (Lecture no-2)	23-01-2024	INMAS, Chattogram	27
16	General Meeting (New year Resolution)"-	16-01-2024	INMAS, Chattogram	37
17	Anomaly scan (Part-2)	19-12-2023	INMAS, Chattogram	07
18	EANM Practice Guidelines for Bone Scintigraphy	12-12-2023	INMAS, Chattogram	06
19	Finalcial matters pension & Gratuity temporary advance,ibass++, adjustment procedures, Budget and other financial benefits	28-11-2023	INMAS, Chattogram	27
20	General Administrative Procedures & BAEC Service rules (Lecture no-1)	21-11-2023	INMAS, Chattogram	29
21	Presentation on NREPC	17-10-2023		41
22	Thyronor CME: "Thyroid Dysfunction in Pregnancy: Treat or Not to Treat?"	30 -09- 2023	INMAS, Chattogram	40
23	National Integrity Strategy (NIS) of Bangladesh	14-07-2023	INMAS, Chattogram	40

4. Stakeholder Meeting

Sl. No	Date	Place	Number of participants
01	07-05-2024	INMAS, Chattogram	29
02	05-02-2024	INMAS, Chattogram	27
03	10-08-2023	INMAS, Chattogram	19

5. Collaboration Work/MOU (ADP/FNCA/MEXT/FTC/IAEA/RCA/TC/S&T/CRP/In-house project, Universities, etc.)

Memorandum of Understanding with the Department of Genetic Engineering & Biotechnology of Chittagong University to establish a framework for cooperation, collaboration, and understanding.

8. Service Rendered

Sl no.	Name of service provided	number/quantity of sample/ patient /service	revenue income (if any)
01	Patient Service	59,159	4,32,91,160/-

INSTITUTE OF NUCLEAR MEDICINE AND ALLIED SCIENCES (INMAS), MYMENSINGH

Objective

The Institute of Nuclear Medicine and Allied Sciences (INMAS), Mymensingh as an organization of Bangladesh Atomic Energy Commission is committed to peaceful use of Atomic Energy in the field of medical science. This institute offers diagnostic & therapeutic Nuclear Medicine services to the people of greater Mymensingh region. Recently, the institute is going to be equipped with MRI and the prestigious Nuclear Medicine PET-CT facilities which is a very useful nuclear technology for diagnosis, staging and follow-up of cancer patients. A host of qualified & skilled doctors and technologists are working in this institute with the purpose:

- To provide specialized medical services to the people using nuclear and high quality ultrasound technology.
- To improve and upgrade Nuclear Medicine facilities in the country.
- To build up skilled nuclear medicine physicians, physicists and technologists through academic & specialized training.

1. Manpower Development (Training /Fellowship/ Workshop/Meeting)

1.1 Attended in Training /Fellowship/Workshop/Meeting

Sl. No	Title of the program	Date	Place	Number of participants
a.	Nuclear and Radiological Emergency Preparedness Course	10-21, September, 2023	TI, AERE, Savar, Dhaka.	01
b.	FTC on Environmental Radioactivity Monitoring	29 Oct to 02 Nov. 2023	TI, AERE, Savar, Dhaka.	01
c.	Factory Visit Program	19-25 November. 2023	Germany	01
d.	Information and Communication Technology Course	03-14 March, 2024	RAPTC, Dhaka	01

2. Organize Training/Fellowship/Workshop/Meeting

Sl. No	Title of the program	Date	Place	Number of participants
a.	Autoimmune thyroid disease & Nuclear Medicine	09 July 2023	INMAS, Mymensingh	17
b.	Nuclear and Radiological Emergency Preparedness	10 October 2023	INMAS, Mymensingh	18
c.	Liver Stiffness Quantification In Biopsy Proven Nonalcoholic Fatty Liver Disease Patients Using Shear Wave Elastography.	23 October 2023	INMAS, Mymensingh	19
d.	Carotid Color Doppler ultrasound in Stroke	06 June 2024	Shaheed Raisul Hasan Noman Auditorium. MMC, Mymensingh.	10

3. Oral/Poster Presentation in Seminar/Symposium/Conference(National and International)

Name of the Participant	Title of oral/poster presentation	Title of the event	Organizer	Date	Place
Prof. Dr M. Nasim Khan, Prof. Dr Ratan Kumar Chacraborty, Dr Shakila Zaman Rima, Dr. Nadiruzzaman, Dr. Rowshan Ara Ruma, , Dr. Nazmun	Ultrasound Evaluation of Extensive Liver Fibrosis due to Hepatic Iron Over	35 th National Conference of Bangladesh Society of Ultrasonography	BSU	27.10.2023 to 28.10.2023	Pan Pacific Sonarga on Hotel,

Nahar Shapla, Dr. Fahima Akhter Dowel, Dr. Nayema Rahman Anu	Load Mimicking Multiple Mass Lesions in a patient with Thalassaemia				Dhaka
Prof. Dr M. Nasim Khan, Prof. Dr Ratan Kumar Chacrabarty, Dr Shakila Zaman Rima, Dr. Rowshan Ara Ruma, , Dr. Nazmun Nahar Shapla, Dr. Fahima Akhter Dowel, Nayema Rahman Anu, Dr.Mahbubur Rahman	Unusual bone metastases in sinunasal squamous cell carcinoma on SPECT-CT Bone Scintigraphy: A rare case report	27 th National Conference of Society of Nuclear Medicine, Bangladesh	SNMB	08.03.2024	Hotel Intercontinental

4. Stakeholder Meeting

Sl. No	Title of the program	Date	Place	Number of participants
a.	Briefing Meeting on Service providing Commitments among the Stakeholders.	21.07.2023	Conference Room, INMAS, Mymensingh	21

5. Collaboration Work/MOU (ADP/FNCA/MEXT/FTC/IAEA/RCA/TC/S&T/CRP/In-house project, Universities, etc.)

IAEA RCA Project “Strengthening Hybrid Imaging in Nuclear Medicine in Asia (RAS 6079)”

6. Service Rendered

Sl no.	Name of service provided	Number/quantity of sample/patient / service	Revenue income
a.	Sample Analysis (including blood sample)	72179	48715080.00
b.	Ultrasound & Color Doppler imaging service	25902	11575230.00
c.	Nuclear & BMD imaging service	4179	4545330.00
d.	Patient care including Radioiodine Therapy & Follow-up	1347	2794400.00
Total:		103607	67630040.00

7. Repair & Maintenance, Renovation works, etc.

- Regular Maintenance of 60 KVA UPS in SPCET/CT Room, 3KVA UPS in BMD and Ultrasound Machine rooms.
- Regular Maintenance of 45 KVA Perkins GPR50 Generator System
- Regular Maintenance of Air Condition System (AC)
- Maintenance of Ultrasound Machine, Problem in Accuvix A10 repaired by our institute senior tech replacing the power supply.
- Regular practicing of QC program of Nuclear Medicine Instruments and assisted in repair and maintenance
- Renovation of a dedicated room for breast-feeding mothers in the institute.
- Renovation of a room of RIA extension space and installation of an Automated RIA machine and CLIA machine.

8. Others

- a) Series of lectures were arranged on SPECT-CT for doctors, scientist & scientific staff of INMAS, Mymensingh
- b) Series of lectures on radiation control and safety were held on during this period for scientific staffs of INMAS, Mymensingh.
- c) Scheduled lectures were delivered routinely to Postgraduate students of different disciplines (MD, MS, DEM) and MBBS students of MMC placed for practical demonstration in INMAS, Mymensingh.

- d) Weekly journal club meeting as continuing medical education program conducted on recent Nuclear Medicine and Allied science related works regularly in this institute.
- e) Participation in weekly clinical meeting and journal club arranged by MMCH & MMC where highlighted Nuclear Medicine and Allied Science related facilities.
- f) The institute provides research facility for post graduate students of MD, MS, M Phil & PhD program of MMC.
- g) This institute provides facility to perform research program in association with other institutes such as MMC & BAU, Mymensingh

INSTITUTE OF NUCLEAR MEDICINE AND ALLIED SCIENCES (INMAS), SYLHET

Objective

Institute of Nuclear Medicine & Allied Sciences, Sylhet is located at the North-East part of the country. It was established in the year of 1980 at Sylhet M.A.G Osmani Medical College campus. The institute provides both diagnostic and therapeutic services by using nuclear technologies & ultrasound system to improve the health care services to the people of greater Sylhet division. The institute also provides academic and research activities to upgrade the knowledge regarding nuclear medicine among the professionals.

1. Manpower Development (Training /Fellowship/ Workshop/Meeting)

1.1 Attended in Intraining/Fellowship/Workshop/Meeting

Sl. No	Title (Training program/Workshop/Seminar/ Symposium/ Conference)	Date	Place	Number of participants
a)	Integrity Training	05-07-23	INMAS, Sylhet	20
	Integrity Training	10-08-23	INMAS, Sylhet	20
b)	Training on Government Service, Behavior Rules & Discipline.	18-09-23	INMAS, Sylhet	19
c)	Integrity Training	14-10-23	INMAS, Sylhet	21
d)	Integrity Training	11-11-23	INMAS, Sylhet	19
e)	Training on Government Service, Behavior Rules & Discipline.	18-12-23	INMAS, Sylhet	16
f)	Integrity Training	14-01-24	INMAS, Sylhet	20
g)	Integrity Training	11-03-24	INMAS, Sylhet	20
h)	Code of conduct and discipline training	05-03-2024 07-03-2024	TI, AERE, Savar, Dhaka	01
i)	iBas+ Training	07-10-2023 08-10-2023	IPF, Segunbagicha, Dhaka	02

4. Stakeholder Meeting

Sl. No	Title of the program	Date	Place	Number of participants
a)	Meeting with participant	19-08-2023	INMAS, Sylhet	24
b)	Meeting with participant	11-03-2024	INMAS, Sylhet	32

5. Service Rendered

Sl no.	Name of service provided	number/quantity of sample/patient / service	revenue income
a)	Patient Service	33,210	2,0634350/-
b)	Sample Analysis (including blood sample)	20030	

5. Others

Placement of MS/MD students at Inmas, Sylhet for Nuclear Medicine Students

Sl. No	Title of the program	Date	Place	Number of participants
a)	Residence of MD (Radiology & Imaging) Phase A	01-04-2024 to 30-04-2024	Inmas, Sylhet	5

b)	Residence of MS (Orthopedics surgery)	16-05-2024 to 31-05-2024	Inmas, Sylhet	3

INSTITUTE OF NUCLEAR MEDICINE AND ALLIED SCIENCES (INMAS), RAJSHAHI

Objective

Institute of Nuclear Medicine & Allied Sciences (INMAS), Rajshahi is located at North West part of the Bangladesh. This Institute provides services to the people of greater Rajshahi and nearby districts using nuclear technology and Ultrasonography and is making a great impact in this region for betterment of health services.

1. Manpower Development (Training/Fellowship/Workshop/Meeting)

1.1 Attended in Training/Fellowship/Workshop/Meeting

Sl. No	Title of the program	Date	Place	No. of Participants
1.	Service and maintenance Training Program	25/02/24 to 09/03/24	Erlangen, Germany	01
2.	Clinical & Operational Training of Dual Head SPECT-CT Scanner at Erlangen, Germany during	06-17/11/23	Erlangen, Germany	01
3	The Japan Society of Ultrasonics in Medicine (JSUM) Fellowship	07/05/24 to 06/11/24	Japan	01

2. Organize Training/Fellowship/Workshop/Meeting

Sl. No	Title of the program	Date	Place	No. of Participant
1.	Seminar on “Papillary carcinoma of thyroid : Managements & updates”	30/12/23	INMAS, Rajshahi	61
2.	MD (Internal Medicine/Oncology) Residency course training	01-07/10/23 13-19/11/23 01-14/02/24 22-28/04/24	INMAS, Rajshahi	09
3.	In-Plant Training of 4th year students of Bio-Chemistry and Molecular biology, University of Rajshahi	18-24/12/23 26/12/23 to 01/01/24	INMAS, Rajshahi	27
4.	Training on Medical Technology (Diploma), IHT, Rajshahi.	30/01/24 to 05/02/24 30/04/24 to 06/05/24	INMAS, Rajshahi	33
5.	Training on Medical Technology (B. Sc), Institute of Health Technology Rajshahi & Rajshahi Institute of Medical Technology.	28/01/24 to 10/02/24 31/03/24 to 13/04/24 16-30/05/24	INMAS, Rajshahi	45

3. Oral/Poster Presentation in Seminar/Symposium/Conference(National and International)

Name of the Participant	Title of oral/poster presentation	Title of the event	Organizer	Date	Place
Dr. Shibli Nishad Alam	Pattern of 99mTc-DTPA Renogram Findings in pediatric Patients attending INMAS, Rajshahi.	Bangladesh Journal of Nuclear Medicine	SNMB	08-03-24	Dhaka
Dr. Tasnim Ahmed	Relationship between PSA level and bone metastasis in newly diagnosed prostate cancer patients referred to INMAS, Rajshahi for bone scan.	Bangladesh Journal of Nuclear Medicine	SNMB	08-03-24	Dhaka
Dr. Fahim Uddin Ahmad	Warthin’s Tumor of Parotid gland: A Case Report	Bangladesh Journal of Ultrasonogram	BSU	27,28-10-24	Dhaka

Dr. Shibli Nishad Alam	Prenatal Diagnosis of Ranula: A Social Rescue	Bangladesh Journal of Ultrasonogram	BSU	27,28-10- 24	Dhaka

4. Stakeholder Meeting

Sl No	Title of the program	Date	Place	Number of participants
1.	mykvmb cŌwZôvi wbwgĚ AskxR†bi AskMŌn†Yi mfv	30-12-23	INMAS, Rajshahi	68

5. Service Rendered

Sl No	Name of service provided	Number/Quantity of sample/patient/service	Revenue Income (BDT)
1.	Patient service	52586	=4,20,16,810/-
2.	Sample analysis(blood)	68119	

INSTITUTE OF NUCLEAR MEDICINE AND ALLIED SCIENCES (INMAS), DINAJPUR

Objective

Institute of Nuclear Medicine and Allied Sciences, Dinajpur was established in the year 1982 at Dinajpur Sadar Hospital campus to serve the endemic goiter zone of greater Dinajpur and Rangpur districts. The main purpose was to serve goiter affected persons both in diagnosis and treatment. In the following decades the Institute served a huge number of patients with different Thyroid Disorders. At the stage of establishment institute was only confined to treat Thyrotoxic patient by ^{131}I but at present we also provide post-operative treatment to Thyroid Cancer patients with ^{131}I ablation. As well as, other nuclear medicine studies e.g. Radioisotope Scan of Thyroid Gland, %RAIU, Dynamic and Static Renal studies, Skeletal Scintigraphy, DEXA Scan for bone mineral densitometry, In-vitro assays of different hormonal status and many others. Its not just the epicenter of Nuclear Medicine in these Dinajpur, Panchagarah & Thakurgaon districts at present but also provides competent different sonological studies and CT scans in the field of Medical Radiology & Imaging.

Activities/Program(s)

1. Both Diagnostic and Therapeutic facilities are available here

1.1 Diagnostic: Both In-vivo and In-vitro techniques are used in this Institute for diagnosis of diseases.

A. **In-vivo technique:** The following tests are performed here for diagnosis of various diseases.

- 1) Thyroid Scan: This test is performed with thyroid scanner to determine the function of thyroid gland.
- 2) Nuclear Imaging: Diseases of bone, brain, liver, kidney, thyroid gland etc. are detected by taking images of the respective organs with Dual Head SPECT.
- 3) BMD: Bone Mineral Densitometry (BMD) is used to assess bone mineral content of the patient for detection of osteoporosis and osteopenia.
- 4) Renogram: This test is performed with SPECT machine to determine the functional status of kidneys.
- 5) SPECT-CT: a) HRCT-Chest, CT-Abdomen with or without contrast, CT-Brain, CT-Orbit, Paranasal sinus, cervical spine, Mastoid bones routinely done. b) Fusion image (SPECT-CT) also performed here.

B. **In-vitro technique:** Thyroid related hormones (T_3 , T_4 , TSH, FT_3 , FT_4 , Tg and Antithyroid Antibody, serum D3, tumor marker) are being estimated in the lab by Radio Immunoassay (RIA) technique and CLIA method.

C. **Ultrasonogram with color Doppler:** Ultrasonogram both conventional and Color Doppler ultrasound available here. In addition with routine USG, Foetal anomaly Scan, NT-Scan routinely performed here.

Therapeutic: (i) Radioactive Iodine ($I-131$) is used for treatment of thyrotoxicosis and thyroid cancer patient.

2. Manpower Development

(Training Program/Workshop/ Seminar/Symposium/Conference)

Sl. No.	Training program/Workshop/Seminar/Symposium/ Conference	Date	Place	No. of Participant

a)	Bangladesh National Training Course on Nuclear Security Recommendations Physical Protection of Nuclear Material and Nuclear Facilities	48 – 22 Sep. 2023	Russia	01
b)	Training on PL-A/C and iBAS++	7 – 8 October 2023	Institute of Public Finance, Dhaka	03
c)	Clinical and Operational Training on Dual Head SPECT-CT	6 – 17 Nov. 2023	Germany	01
d)	Training Course on PPR-2008 and Public Procurement Management	28 Janu – 08 Feb'2024	TI, AERE, Savar, Dhaka	01
e)	Servicing and Maintenance Training Programme	25 Feb – 9 March 2024	Germany	01
f)	Training on Service code of conduct and rules and regulation of staff.	5 – 7 March 2024	TI, AERE, Savar, Dhaka	01

3. Attended in Seminar/Symposium/Conference/Workshop/Meeting

Name of the Participant	Title of the event	Organizer	Date	Place
i) Najnin Hossain, Joining Secretary, MOST, Dhaka. ii) Khan Md. Reza-Un-Nobi, Deputy Secretary, MOST, Dhaka. iii) Dr. B. K. Bose, Director, INMAS, Dinajpur. iv) Many other Doctor and other elite person of Dinajpur.	Meeting to inform about the grievance redress system (GRS) with the stakeholders.	Ministry of Science and Technology	26 Dec. 2023	Auditorium INMAS, Dinajpur
i) Md. Hanif Shikder, Deputy Secretary, MOST, Dhaka. ii) Dr. B. K. Bose, Director, INMAS, Dinajpur. e) All Employees INMAS, Dinajpur.	Meeting for raising public awareness about right to information act its rules and regulation.	Ministry of Science and Technology	02 March 2024	Auditorium INMAS, Dinajpur
a) Dr. B. K. Bose, Director, INMAS, Dinajpur. b) Dr. Tanvirul Hasan, Medical Officer, INMAS, Dinajpur. c) Dr. Md. Khayerul Alam, Medical Officer, INMAS, Dinajpur. d) Md. Milon Ali, Senior Scientific Asst. INMAS, Dinajpur. e) Zakir Hossain, Senior Scientific Asst. INMAS, Dinajpur.	27 th National Conference of SNMB-2024	Society of Nuclear Medicine Bangladesh	08 March 2024	Hotel Intercontinental, Dhaka, Bangladesh
Dr. B. K. Bose, Director, INMAS, Dinajpur (Resource Person)	Orientation on Diagnosis of TB by Chest Radiography	DGHS	07 Feb. 2024 08 Feb. 2024	Auditorium INMAS, Dinajpur

4. Repair & Maintenance, Renovation works, etc

Under the project of “Enhancing Capacity of INMAS at Dhaka, Chittagong, Khulna, Sylhet, Rajshahi, Dinajpur and Rangpur” Renovation works done. Thyroid Uptake System, BMD Machine, Color Doppler Ultrasonography, Dual Head SPECT, Dual Head SPECT-CT Machine installed in the institute by this project.

4. Stakeholder Meeting

- i) Najnin Hossain, Joining Secretary, MOST, Dhaka. 26-12-2023
- ii) Khan Md. Reza-Un-Nobi, Deputy Secretary, MOST, Dhaka. 26-12-2023
- iii) Md. Hanif Shikder, Deputy Secretary, MOST, Dhaka. 02-03-2024

INSTITUTE OF NUCLEAR MEDICINE AND ALLIED SCIENCES (INMAS), RANGPUR

Objective

Institute of Nuclear Medicine and Allied Sciences, Rangpur is located in the northern part of the country in the premises of Rangpur medical College Hospital. The Institute provides diagnostic & therapeutic services to the people of Northern part of Bangladesh covering greater Rangpur, part of greater Bogra & Dinajpur using Nuclear technology & ultrasound system. Since inception in 1989 the Institute made a great impact in this region for the betterment of health services.

Programme(s)

1. R&D works(s)

By using invivo & in vitro nuclear techniques & ultrasound various R & D programmes are going in relation to hypothyroidism, thyrotoxicosis thyroid cancers, renal diseases foetal maturity & hepatobiliary diseases scientific discussions on journals collected through Internet are done time to time.

2. Manpower Development

SI. No.	Title (Training program/Workshop/Seminar/Symposium /Conference)	Date	Place	No. of Participant
a)	Industrial Training programme Diploma-in-Engineering for the Department of Electro-Medical .	12 week, 13/08/2023 to 12/11/2023	I NMAS, Rangpur.	11

3. Attended in Seminar/Symposium/Conference/Workshop/Meeting

Name of the participant	Title of the event	Organizer	Date	Place
Dr. Md. Murshed Ali. Chief Medical Officer & Director	1. Regional Training Course on Hybrid Imaging and Therapeutic Nuclear Medicine Technologies and Its Applications in Thyroid Conditions Including Liver and Prostate Cancer Theragnostics to be held at Lahore.	IAEA	08-19 May.2017	Faisalabad in Pakistan
	2. “Pre-Shipment Visit on Nuclera tof-Pet with Associate Accessories” to be held at Philips Healthcare.	Visit	17-23 Sep. 2017	Cleveland, Ohio, USA
	3. “The Clinical Training on Color Doppler with 4D Ultrasound” Project.	Training	13-19 October,2018	India.
	4. “Clinical, Operational and Service training of Dual Head SPECT-CT” at Mediso Imaging System Ltd.	Project	01-12 April 2019	Budapest, Hungary
	5. “Society of Nuclear Medicine and Molecular Imaging (SNMMI)-at during	Annual Meeting	22-25 June 2019	Anaheim, California, USA.
	6. The Regional Workshop on Nuclear Medicine Applications (SPECT and PET) in the Diagnosis of Neurological Conditions,	Project	29 July-02Aug. 2019	Tokyo, Japan
	7. Clinical and Operational Training on Bone Mineral Densitometry (BMD) at Medilink, 393 Rue Charles Lindbergh, 34130 Manguio,	Project	18-24 Nov. 2019	France
	8. Operation & Clinical Training on Dual Head SPECT-CT.	Training	08-21 May 2022	Germany

Name of the participant	Title of the event	Organizer	Date	Place
	9. Ultrasonographic evaluation of disease of hepatobiliary system in northern part of Bangladesh. Scholars journal of applied Medical Sciences.(Volume-19, P-2566-68, 2020-21) 10. Radionuclide Synovectomy in Inflammatory Arthritis-Prospect in Bangladesh. Scholars journal of applied Medical Sciences.(Volume-19, P-2569-72, 2020-21) 11. Comparison of thyroid status of school children between the low and high socioeconomic groups. Scholars journal IOSR journal of Dental & medical Science. (IOSR-JDMS). e-ISSN:2279-0853, p-ISSN: 2279-0861, Vol -19,P-19-22, Nov.2020) 12. Assessment of Socio demographic status of thyroid cancer patient at institute of Nuclear Medicine & Allied sciences,Rangpur.(Journal of Rangpur Medical College,Vol-6, march2021, P7-10, ISSN-2618-0413) 13. Sonographic Evaluation of Female Pelvic masses at Institute of Nuclear Medicine & Allied Sciences,Rangpur, (Journal of Rangpur Medical College,Volume-6, march 2021, P37-41, ISSN-2618-0413)			
Dr. Mrs. Sadia Afroz Choudhury, Principal Medical Officer	1. Regional Training Course On the Development and Clinical Application of Radiosynovectomy Agents.	IAEA	14-18 November,2016	Quezon City in Philippines
	2. Clinical Training on High Grade Color Doppler Ultrasound	Project	19-31, August,2019	India
	3. Nuclear Technology Seminar-2019: Basic Radiation Knowledge for School Education Course	IAEA	24 October-08 November-2019	Japan
	4. Operation & Clinical Training on Dual Head Spect-CT	Training	08-21/ May 2022	Germany
	5. Assessment of Socio demographic status of thyroid cancer patient at institute of Nuclear Medicine & Allied sciences,Rangpur.(Journal of Rangpur Medical College,Vol-6, march2021, P7-10, ISSN-2618-0413) 6. Sonographic Evaluation of Female Pelvic masses at Institute of Nuclear Medicine & Allied Sciences,Rangpur, (Journal of Rangpur Medical College,Volume-6, march 2021, P37-41, ISSN-2618-0413) 7. Fetal outcome in preterm prelabour ruptures of Membrane in different gestational age. (Journal of Rangpur Medical College,Volume-6, march 2021, P 52-56, ISSN-2618-0413)			
Dr. Musrat Jahan, Principal Medical Officer	1. Clinical and Operational Training on Bone Mineral Densitometry (BMD) at Medilink, 393 Rue Charles Lindbergh, 34130 Manguio	Project	18-24 November 2019	France
	2. Nuclear Technology Seminar-2019: Basic Radiation Knowledge for School Education Course.	Training	24May -08 Jun-2017	Japan
	3. Assessment of Socio demographic status of thyroid cancer patient at institute of Nuclear Medicine & Allied sciences,Rangpur.(Journal of Rangpur Medical College,Vol-6, march2021, P7-10, ISSN-2618-0413) 4. Sonographic Evaluation of Female Pelvic masses at Institute of Nuclear Medicine & Allied Sciences,Rangpur, (Journal of Rangpur Medical College,Volume-6, march 2021, P37-41, ISSN-2618-0413)			
Mr. Md. Shafiqul Islam, Technical Officer	“Clinical, Operational and Service training of Dual Head SPECT-CT” at Mediso Imaging System Ltd.	Project	01-12 April 2019	Budapest, Hungary
Mr. Md. Wares Ali, Technical Officer	Operational Training program of the Single Head Gamma Camera.	Project	24-28 June 2019	Hungary.

3. Stakeholder Meeting

Establishment of good governance rectification of allegation by the Stakeholder's participation meeting held at the seminar hall of INMAS, Rangpur 08 Jun/2024. Chief guest honorable Joint Secretary(Admin) Najnin Hossain.

4. Academic Activities

i) The Institute is carrying out academic activities in Collaboration with the Department of Physiology, Endocrinology, Gynecology & Oncology Dept of Rangpur Medical College Hospital.

ii) Arranged scientific & technical discussions on Nuclear Medicine & Ultrasonography for our newly appointed doctors & scientists.

5. Service Rendered

SI NO.	Number of Service Provided	Number/Quantity of Sample/patients/service	Revenue Income
a)	Patient Service	20458	1,60,10,500.000
(b)	Sample Analysis(including blood sample)	16300	96,2,1900.00
Total		36758	2,56,32,400.00

INSTITUTE OF NUCLEAR MEDICINE AND ALLIED SCIENCES (INMAS), KHULNA

Objective

- To provide diagnostic and Therapeutic services to the patients using nuclear technology and ultrasound system and to conduct academic and research activities
- To promote better understanding of nuclear medicine services among the medical professional
- To improve and upgrade nuclear medicine facilities concerning local perspectives
- To facilitate research and development works in the relevant fields

1. Manpower Development (Training/Fellowship/Workshop/Meeting)

1.1 Attended in Training/Fellowship/Workshop/Meeting

Sl. No	Title of the program	Date	Place	Number of participants
01	Training on Myocardial Perfusion Imaging, Bone Scan, Reno gram, HIDA Scan and Lymphoscintigraphy	17/09-21/09/2023	INMAS, Dhaka	01
02	Fundamental Training Course (Grade 13 to 16)	10/03-28/03/2024	RPATC, Khulna	01
03	Training on Musculoskeletal System and Interventional Ultrasound	19/05-23/05/2024	INMAS, Dhaka	01

2. Organize training/fellowship/workshop/meeting

Sl. No	Title of the program	Date	Place	Number of participants
01	Clinical Training	17/12-28/12/2023	INMAS, Khulna	02
02	In-house Training Workshop on National Integrity Strategy.	23/04/2024	INMAS, Khulna	25
03	In-house Training Workshop on GRS Software and Patient Management System.	24/04/2024	INMAS, Khulna	23

3. Oral/Poster Presentation in Seminar/Symposium/Conference(National and International)

Name of the Participant	Title of oral/poster presentation	Title of the event	Organizer	Date	Place
Dr. S. M. Nazim Uddin	Nuclear Medicine Procedures in Diagnosis and Treatment	Monthly Seminar (CME)	KMC	01 August, 2023	KMC

	of Thyroid Diseases				
Dr. Jharna Das	Nuclear Medicine Imaging in Thyroid and Parathyroid Disorder	-	Medicine & Allied department of KMCH	26 September, 2023	KMCH
Dr. Ashima Pervin	Comparative study between 99m pertechnetate scan with percentage uptake and radioiodine uptake (I-131) in hyperthyroid patients – An institute based experience	27 th National Conference of Society of Nuclear Medicine, Bangladesh	SNMB	08 March, 2024	Hotel Intercontinental, Shahbag, Dhaka
Dr. Jharna Das	PET/PET-CT: An Overview	-	Medicine & Allied department of KMCH	20 February, 2024	KMCH
Dr. S. M. Nazim Uddin	Thyroid Ultrasound: An overview on TI-Rads	Scientific Seminar	Department of Otolaryngology & Head Neck Surgery, KMCH	23 January, 2024	KMCH

6. Stakeholder Meeting

Sl. No	Title of the program	Date	Place	Number of participants
01	Meeting with stakeholders for the establishment of good governance.	31 March, 2024	INMAS, Khulna	70

7. Service Rendered

Sl.no.	Name of service provided	number/quantity of sample/patient/service	revenue income
01	Diagnostic and Therapeutic	44,995	Tk. 2,89,67,040.00

INSTITUTE OF NUCLEAR MEDICINE AND ALLIED SCIENCES (INMAS), BARISHAL

Objective

Institute of Nuclear Medicine and Allied Sciences, Barishal has been established in the year of 1989 with the aim of peaceful application of nuclear science for the betterment of the human health at the Campus of Sher-e-Bangla Medical College and Hospital. The Institute delivers its service mostly to the patients attending the Sher-e-Bangla Medical College Hospital and also to the people of the Barishal Division and as well as people of the neighbouring districts like Madaripur, Gopalgong, Pirojpur, Bagerhat etc. With the course of time the service and facilities of the Institute is increasing day by day. The number of patients and amount of revenue earning is increasing every year but the institute is providing its services with the same manpower as it was at the time of establishment. It is now a four storied building, the renovation of the building and establishment of the modern equipment was done time to time since its establishment. Recently the renovation/modification/beautification of the existing building is going on with installation of advanced medical and office equipment, under the ADP project- “Enhance Capacity of The Institute of Nuclear Medicine and Allied Sciences at Mitford, Cumilla, Faridpur, Barishal and Bogura”. After the completion of the project work the Institute will get a new look and patients will get benefits of advanced technologies, easier services and comfortable waiting spaces and the staffs of the institute will get good working environment.

1. R&D work(s)

1.1 Outcome of Radioiodine Therapy in Papillary Thyroid Carcinoma- 12 Years Experience in INMAS, Barishal.

N Jahan, F. Sharmin, N. Jahan, S. Hossen.

Radioiodine therapy after surgery is an effective method for well differentiated thyroid carcinoma and had good prognosis. RAIT has started in 2010 in INMAS, Total patients received RAIT in this center from 2010-2021.

Follow up time extended upto december 2023 to evaluate the treatment response. The patients were referred to the center for radioiodine therapy after total of near total thyroidectomy. Radioiodine therapy was given 4 weeks after surgery when serum TSH level raised >30 mIU/L. Patients received 30-100 mCi of radioiodine, who had no metastasis, 150 -200 mCi with lymph node and distant metastases. Usually post therapy scan was done at 5th post therapy day and patients were released when survey meter count is < 20 microSv/h at 1 meter distance. Thyroid replacement therapy was given to the patients to maintain TSH $<0.1 - 0.5$ mIU/l. Then regular follow up were done in every three month in first year. In every follow up serum TSH, Tg, T Ab, HRUS of neck and serum calcium were done. First whole body iodine scan were done at 6-12th month. Radioiodine therapy after surgery is an effective method for well differentiated thyroid carcinoma and had good prognosis.

2. Manpower Development(Training/Fellowship/Workshop/Meeting)

2.1 Attended In Training/Fellowship/Workshop/Meeting

Sl. No	Title of the program	Date	Place	Number of participants
1.	Remedy of dispute & GRS software and Right of Information Act	09/05/24	Zoom platform	2
2.	APA 3 rd quarter Feedback meeting	18/01/24	Zoom platform	2
3.	PL-A/C & iBAS++	7-8/10/23	IPF, Dhaka	2
4.	The Government Servants (Conduct rules) & Discipline related training	5-7/3/24	TI, ARE, Savar	1

3. Organize Training/Fellowship/Workshop/Meeting

Sl. No	Title of the program	Date	Place	Number of participants
1	Scientific Seminar on “Management of Thyroid Disease in Nuclear Medicine” Organized by: Institute of Nuclear Medicine & Allied Sciences, Barishal & Enhance Capacity of Institute of Nuclear Medicine & Allied Sciences (INMAS) at Mitford, Cumilla, Faridpur, Barishal and Bogura (1 st Revision) Bangladesh Atomic Energy Commission	23/12/2023	Auditorium, INMAS, Barishal	70
2	Arranged In-house Training for Officers & Staffs of INMAS, Barishal for National integrity	27/09/2023 28/11/2023 22/01/2024 09/05/2024	Auditorium INMAS, Barishal	Officers = 09 Staff =18 (per training day)
3	Arranged In-house Training for Officers & Staffs of INMAS, Barishal for Right of information act	30/09/2023 06/12/2023 13/03/2024 25/06/2024	Auditorium INMAS, Barishal	Officers = 08 Staff =18 (per training day)

4. Oral /Poster Presentation in Seminar/Symposium/Conference(National and International)

Name of the Participant	Title of oral presentation	Title of the event	Organizer	Date	Place

Dr. Nafisa Jahan, CMO & Director	Management of Thyroid Disease in Nuclear Medicine	Scientific Seminar on “Management of Thyroid Disease in Nuclear Medicine”	Institute of Nuclear Medicine & Allied Sciences, Barishal & Enhance Capacity of Institute of Nuclear Medicine & Allied Sciences (INMAS) at Mitford, Cumilla, Faridpur, Barishal and Bogura (1 st Revision) Bangladesh Atomic Energy Commission	23/12/2023	Auditorium, INMAS, Barishal

5. Stakeholder Meeting

Sl. No	Title of the program	Date	Place	Number of participants
1	Arranged Seminar for Stakeholders, doctors (SBMCH & INMAS), officers & staff for good governance	25/09/23 17/12/23	Auditorium, INMAS, Barishal	60 55
2	Establishing dispute prevention & good governance	14/02/24 21/05/24	Auditorium, INMAS, Barishal	62 70

6. Academic Activities

- Lectures delivered to 3rd year (52th batch) students of SBMC on 12-16 July 2023.
- 6 months training on Ultrasonography and Clinical Nuclear Medicine to 1 Doctor.

7. Service Rendered

Sl no.	Name of Service Provided	Number/Quantity of Sample/Patient /Service	Revenue Income
1	Clinical Nuclear Medicine Ultrasonography Blood Sample study	Total number of patients 36317 USG=14313, Blood sample=(20107+1396)=21,503 Others patient service=501	2,00,73,870/-

8. Repair & Maintenance, Renovation works, etc.

Enhance Capacity of Institute of Nuclear Medicine & Allied Sciences (INMAS) at Mitford, Cumilla, Faridpur, Barishal and Bogura (1st Revision) Bangladesh Atomic Energy Commission

Renovation, modification, beautification of the existing building with horizontal extension, installation of Substation, SPECT CT, Dual head SPECT, thyroid camera, thyroid uptake system, BMD, RIA counter, CLIA, high definition ultrasonography machine etc. is going on under the project.

INSTITUTE OF NUCLEAR MEDICINE AND ALLIED SCIENCES (INMAS), FARIDPUR

Objective

Institute of Nuclear Medicine & Allied Science (INMAS), Faridpur was established along with other three institute in Mitford, Commilla and Bogra as a common project. The institute is situated in the premises of Faridpur medical college hospital. The foundation stone was led on 15 September 1995, construction was completed in early 1997 and the institute started running in October 1997. Patients from greater Faridpur

district and adjacent areas usually attend the institute to receive nuclear medicine services. The institute has been rendering services through its following scientific divisions.

1. Nuclear scanning /Scintigraphy
2. Thyroid Division
3. In-vitro Nuclear Medicine
4. Therapeutic Nuclear Medicine
5. Ultrasound division

1. Manpower Development(Training /Fellowship/Workshop/Meeting)

1.1 Attended in Training/Fellowship/Workshop/Meeting

Sl. No	Title of the program	Date	Place	Number of participants
01	Basic Nuclear Medicine and Administration” for officers and staff	19-27 June, 2024	INMAS, Faridpur	30

2. Stakeholder Meeting

Sl. No	Title of the program	Date	Place	Number of participants
01	Ganasunani		INMAS, Faridpur	30

3. Service Rendered

Sl No.	Name of Service Provided	Number/Quantity Of Sample/Patient /Service	Revenue Income
1	Patients Service including Ultrasound Doppler, Scintigraphy, Radioiodine therapy	12902	1,55,65,500/-
2	Blood sample	16942	1,55,65,500/-
	Total	- 29,8,44	

INSTITUTE OF NUCLEAR MEDICINE AND ALLIED SCIENCES (INMAS), BOGURA

Objective

The Institute of Nuclear Medicine & Allied Sciences, Bogura is a government institute of specialized and applicable research-oriented health services. The government fund and labors are totally used here for public health service and mankind. The main objective of the Institute is to apply atomic energy in a safe and peaceful way for the well-being of mankind, rather than to use it in destruction. The Institute is mainly involved with diagnosis and treatment of various human diseases using radiopharmaceuticals. Academic and research activities are also performed here. Dual Head SPECT Gamma Camera, BMD, Thyroid Uptake System, Gamma Counter, Pterygium Applicator, Ultra sonogram with Color Doppler and other associated ultra-modern equipment's are available in this institute.

1. Manpower Development(Training/Fellowship/Workshop/Meeting)

1.1 Attended in Training/Fellowship/Workshop/Meeting

Sl. No	Title of the program	Date	Place	Number of participants
1	FTC on Nuclear and Radiological Emergency Preparedness	10/09/2023	TI, BAEC	1
2	PL/AC & iBAS++	07/10/23-08/10/23	IPF,Dhaka	2
3	PPR-2008 & Public Procurement Management	28/01/24-08/02/24	TI, BAEC	1
4	PvKzixi AvPiYwewa I wbqg k,,•Ljv msµvšÍ cÖwkÿY †Kvm©	05/03/24-07/03/24	TI, BAEC	1

2. Oral/Poster Presentation in Seminar/Symposium/Conference

Name of the Participant	Title of oral/poster presentation	Title of the event	Organizer	Date	Place
Dr. Md. Abdul Awal	-	26 th National Conference- SNMB	SNMB	08/03/2024	Intercontinental Hotel, Dhaka
Md. Faruk Hossain	Workplace Radiation Monitoring and Analysis: A Single Institution Based Study				
Dr. Nazia Tarannum	-				
Md. Zillur Rahman	-				
Md. Arman Ali	-				
Md. Abdus Sobhan Akanda	-				
Md. Mizanur Rahman	-				
Mst. Shahinur Begum	-				

3. Stakeholder Meeting

Sl. No	Title of the program	Date	Place	Number of participants
01	Stakeholder Meeting	20/12/2024	INMAS,Bogura	07
02	Stakeholder Meeting	10/03/2024	INMAS,Bogura	07
03	Public Hearing	16/05/2024	INMAS,Bogura	08

4. Service Rendered

Sl No.	Name of service provided	Number of Patient Services	Revenue Income
1	Patient Services	43297	24,702,080.00

INSTITUTE OF NUCLEAR MEDICINE & ALLIED SCIENCES (INMAS), CUMILLA

Objective

One aspect, of the peaceful use of nuclear energy is the medical use of nuclear energy. Nuclear medicine is a specialized procedure that uses radioactive isotopes for diagnosis and treatment. INMAS, Cumilla in one of them. INMAS, Cumilla is established in 1996. which located at Cumilla Medical College Campus. This institute provides diagnostic and therapeutic treatment service by using nuclear medicine technique, Ultrasound & Color duplex Case of the patients east part of Bangladesh covering Cumilla, Feni, Noakhali, Chandpur, Laxmipur, B.barua etc.)

1. R&D work(s)

- The center is equipped with the latest medical equipment. The center has a SPECT machine. Thyroid Scanner machine, Thyroid Uptake system, BMD machine, 3D Ultra sonogram machine, Color Doppler machine. Well equipped RIA Laboratory, Moreover, radioactive iodine therapy is available for hyperthyroid and thyroid cancer patients. Also training is being provides in this institute to help the doctors (Outside of BAEC) to improve their skills in Nuclear Medicine.
- Repair & Maintenance, Renovation works: "Capacity building project INMAS, Cumilla" is in progress.
- Others: Regular follow up for thyroid patients.

2. Manpower Development(Training /Fellowship/ orkshop/Meeting)

2.1 Attended in Training/Fellowship/Workshop/Meeting

Sl. No	Title of the program	Date	Place	Number of participants
a)	"Smart, Bangladesh"	21,22 Jan 2024	(Seminar Room	20

			INMAS, Cumilla)	
b)	"D-nothi & iBAS++"	04,06 June 2024	(Seminar Room INMAS, Cumilla)	20

3. Organize Training/Fellowship/Workshop/Meeting

Sl. No	Title of the program	Date	Place	Number of participants
	<i>Example</i> : 27th National Conference Society of Nuclear Medicine, Bangladesh (SNMB)	8 March, 2024	Hotel Intercontinental, Dhaka	1

4. Service Rendered

Sl No.	Name of service provided	Number/Quantity of Sample/Patient /Service	Revenue Income
a.	Sample Analysis - (Blood Sample, Ultrasound, Color Doppler, Renogram, Bone Scan, Thyroid Scan, Thyroid Uptake, Cancer therapy & Follow up).	35066	2,48,82,700/-

11. Repair & Maintenance, Renovation works, etc. Enhancing Capacity Project of INMAS, Cumilla ongoing.

INSTITUTE OF NUCLEAR MEDICINE AND ALLIED SCIENCES (INMAS), COX”S BAZAR

Objective

- Ensuring safe use of nuclear medicine in diagnostic and therapeutic procedures.
- Ensuring clinical use of radionuclides applied in nuclear medicine.
- Development of skilled human resources in the field of nuclear science and technology.
- Ensuring safety and peaceful use of nuclear energy.
- Expanding the uses of nuclear energy.
- Expanding the uses of nuclear technology in medical service.
- Increase research capacity in science and technology.
- To increase transparency and ensure accountability in official activity.

1. Manpower Development (Training/Fellowship/Workshop/Meeting)

1.1 Attended Intraining/Fellowship/Workshop/Meeting

Sl. No	Title of the program	Date	Place	Number of participants
01	Clinical Training of Dual Head SPECT Scanner with accessories at Mediso Medical Imaging Systems Ltd in Hungary.	16 Mar.- 01 Apr 2024	Hungary	01
02	Clinical Training & Service Training of Thyroid Camera with Accessories at MIE medical imaging electronics GmbH in Germany	25 Feb –04 Mar 2024	Germany	01
03	FTC on Environmental Radioactivity Monitoring Course	29 Oct- 02 Nov 2023	TI, AERE, Savar	01
04	FTC on Reactor Engineering Course	02 Dec- 14 Dec 2023	TI, AERE, Savar	01
05	FTC on Nuclear and Radiological Emergency Preparedness	30 Jul- 10 Aug 2024	TI, AERE, Savar	01

2. Stakeholder Meeting

Sl. No	Title of the program	Date	Place	Number of participants
01	Service Improvement and Awareness program	11 Sep 2023	Inmas Cox's Bazar	42
02	Service Improvement and Awareness program	26 Dec 2023	Inmas Cox's Bazar	38
03	Service Improvement and Awareness program	14 Mar 2024	Inmas Cox's Bazar	27

3. Service Rendered

Sl No.	Name of service provided	Number/Quantity of Sample/Patient / Service	Revenue Income
01	Patient Service including Ultrasound Doppler, Scintigraphy, Radioiodine therapy, follow-up	4177	46,64,150/-
02	Sample Analysis	3186	
	Total	7363	46,64,150/-

INSTITUTE OF NUCLEAR MEDICINE AND ALLIED SCIENCES (INMAS), SUHRAWARDY

Institute of Nuclear Medicine & Allied Sciences, Suhrawardy, is one of the newest nuclear medicine institutes in the country. After the completion of the project, INMAS, Suhrawardy quickly started offering specialized services to the people since September 18, 2023. The institute is equipped with cutting-edge SPECT cameras for oncology, cardiology, nephrology, and cerebral studies, along with state-of-the-art hybrid imaging like Positron Emission Tomography-Computed Tomography (PET-CT) for molecular imaging, High Resolution Ultrasound with Color Doppler, Chemiluminescence Immunoassay System for Hormone Test, Thyroid Uptake, Gamma Counter, and DEXA scan for Bone Mineral Densitometry (BMD) test.

Activities

1. R & D works

1.1 PET-CT: Positron emission tomography (PET) is increasingly used in diagnosing and staging malignant diseases, image-guided therapy planning, and treatment monitoring. FDG PET complements conventional anatomic imaging modalities like CT and magnetic resonance imaging. Aligning CT and PET data sets with fusion software is successful in the brain, but challenges exist in other areas. The combined PET/CT scanner allows for accurate registration of anatomic and functional images in a single session.

1.2 DEXA Bone mineral density (BMD) study : Osteoporosis diagnosis and treatment monitoring are challenging due to the numerous available tests and interpretation complexities. Bone mineral density (BMD) testing, the gold-standard technology, can predict fracture risk. The optimal testing strategy depends on local availability and affordability. As this test is offered in a much lower price than other private hospitals, analysis of risk factors of osteoporosis in different-aged men and women in Bangladesh are now easily possible. BMD is reported as a T-score, and standardized methodologies are being developed to establish cost-effective intervention thresholds for pharmacological therapy.

1.3 Ultrasound-guided aspiration of pleural and ascitic fluid : The diagnosis of patients with ascites of unclear origin and analyzing the nature of ascites by fine needle aspiration-guided ultrasonography.

1.4 Introduction of saline infusion sonography (SIS) : A comparative study of transvaginal sonography (TVS) and saline infusion sonography (SIS) to diagnose uterine cavity abnormalities

1.5 Radioiodine ablation of differentiated thyroid carcinoma patients with management and prognosis analysis:

Well-differentiated thyroid cancer (WDTC) is rising in incidence across the world over the past 3 decades. We aimed to evaluate the natural history and clinical outcome of differentiated thyroid carcinoma treated at this institute. Research on the management of radioactive iodine (RAI) refractory DTC is particularly of interest.

1.6 Evolution of renal anomalies by DTPA renogram and DMSA renal scan:

Complete analysis and evaluation of patients with renal anomalies by DTPA renogram and DMSA renal scintigraphy

1.7 Evaluation of osteomyelitis by 3-phase bone scans:

Evaluating the osteomyelitis using three phase bone scan and comparison of immediate image with 2 to 3 hour delayed image for complete analysis.

1.8 Effect of freeze thaw cycle on the stability of multiple hormone parameters:

To study the influence of repeated freezing and thawing of plasma (serum) on multiple hormone parameters (FT3, FT4, TSH, S. calcium, etc.)

1.9 Decontamination of Tc^{99m} in radioactive waste water:

To explore the radiation safety protocol of waste water management in nuclear medicine facilities.

1.10 Effect of Transition Metal (Fe, Co, Ni, Cu, Zn) Doping in 2D Ti_2C MXene for ion- storage application:

Theoretically analyze the effect of different transition metal on 2D transition metal carbide layer for energy storage application.

2. Manpower Development and Training Programme

Name of the participants	Title of the event	Organizer	Date	Place
Prof. Dr. Zeenat Jabin	Clinical Training of Dual Head SPECT Gamma Camera at Mediso Medical Imaging Systems Ltd	Mediso medical imaging	17 th -30 th November, 2023	Hungary
Prof. Dr. Zeenat Jabin	Clinical Training & Service Training of Thyroid Camera with Accessories at MIE medical imaging electronics GmbH	MiE medical imaging electronics	26 th February- 03 rd March, 2023	Germany
Kazi Reazuddin Ahmed	Training of Automatic Radioimmunoassay (RIA) Counter with liquid handling system	Other	27 th May- 02 nd June, 2024	India
Dr. Jerin Sultana, Sudipto Das	Training Session on current affairs and capacity building of employees	BAEC	04 th September, 2023	BAEC, HQ
Kazi Reazuddin Ahmed	Training on “Right to information Act”, “Grievance Redress System and GRS Software” and “Annual Confidential Report”	BAEC	21 st December, 2023	BAEC, HQ
Sudipto Das	Training Course on Radiation Protection for Radiation Workers and RCOs of BAEC, Medical	BAEC	2 nd -6 th June, 2024	TI, AERE

	Facilities & Industries-2024			

3. Attended in Seminar/ Symposium/ Conference/ Workshop/ Meeting

Name of the participants	Title of the event	Organizer	Date	Place
Prof. Dr. Zeenat Jabin, Dr. Mariom Nusrat, Dr. Ilteza Tabassum, Dr. Rezwana-Ul-Haque, Sudipto Das, Kazi Reazuddin Ahmed	27 th National Conference of Society of Nuclear Medicine, Dhaka	SNMB	8 th March, 2024	Hotel Intercontinental, Dhaka, Bangladesh
Prof. Dr. Zeenat Jabin, Dr. Jerin Sultana, Dr. Ilteza Tabassum	35 th National Conference of Bangladesh Society of Ultrasonography	BSU	27 th October, 2023	Hotel Pan Pacific, Dhaka, Bangladesh
Prof. Dr. Zeenat Jabin	Bangladesh International Cancer Congress 2023	Oncology Club	14 th - 15 th September, 2023	Radisson Blu Water Garden Hotel, Dhaka
Prof. Dr. Zeenat Jabin	National Conference of Bangladesh Thyroid Society	BTS	20 th October, 2023	Hotel Pan Pacific, Dhaka

4. Arranged Training

- Training on the operation of patient entry software, the e-Token kiosk, and the elevator.
- Training on patient care and management for ultrasonography, BMD, PET-CT, and scintigraphy.
- Training on blood collection and serum preparation and storage.
- Operational training on the USG machine, CLIA and RIA machines, BMD machine, gamma camera, and PET-CT scanner.
- Clinical training on USG, PET-CT, and scintigraphy reporting.

5. Stakeholders meeting

- Meeting with stakeholders was arranged on 25th March, 2024 and 12th May, 2024 as part of National Integrity Strategy.

6. Others

- Sudipto Das is serving as RCO
- Prof. Dr. Zeenat Jabin, Dr. Jinia Afrin Khan, Dr. Jerin Sultana, Dr. Rezwana-Ul-Haque and Kazi Reazuddin Ahmed are serving as the members of the ethics committee.
- Kazi Reazuddin Ahmed is serving as seminar convener for weekly scientific seminar

INSTITUTE OF NUCLEAR MEDICINE AND ALLIED SCIENCES (INMAS), MOHAKHALI

The Institute of Nuclear Medicine & Allied Sciences, Mohakhali was established along with other seven institutes in Suhrawardy, Gopalganj, Jessore, Pabna, Cox's Bazar, Satkhira and Kushtia as a common project in 2023. The foundation stone was laid in 2017, and construction was completed in 2022. It is a government institute that provides relevant, specialized and research-based healthcare services, located on the campus of National Institute of Diseases of the Chest and Hospital (NIDCH), Mohakhali, Dhaka-1212.

Objectives

The institute's main goal is to harness atomic energy for people in a safe and peaceful manner rather than for destructive purposes.

- Develop and implement advanced nuclear medicine technologies and services, including PET-CT, Bone Scans, Renograms, RIA, CLIA, and Thyroid treatments, to enhance diagnostic accuracy and treatment outcomes.
- Foster scientific research in nuclear medicine to innovate new diagnostic and therapeutic approaches for cancer and other diseases.

- Implement digitalization strategies to establish INMAS Mohakhali as a one-stop center for comprehensive nuclear medicine services, ensuring efficient patient management and access to specialized treatments.
- Develop skilled human resources through robust educational programs and training initiatives in collaboration with universities and international partners.

These objectives underscore our commitment to advancing healthcare capabilities, fostering innovation, and building a skilled workforce capable of meeting future healthcare demands in Bangladesh

Activities

The services rendered by the institute are:

- Clinical (both diagnostic and therapeutic)

All services are provided under the following divisions

- 1) PET-CT Division
- 2) Scintigraphy Division
- 3) Thyroid Division
- 4) In-vitro Division
- 5) Ultrasound and Color Doppler Division

Regular Services

1. Clinical Activities

1.1 Diagnostic Activities

a) The Institute is equipped with one (01) PET-CT facility. PET-CT scan is very useful for early diagnosis and staging of cancer for the people of Bangladesh.

b) The institute is equipped with one (01) SPECT-CT, and two (02) SPECT Gamma Cameras. The studies include Bone scan, Renal scan (DTPA, DMSA and GFR measurements), Cardiac scan, Lymphoscintigraphy, Thyroid Scan, Parathyroid scan, etc.

c) Thyroid Imaging and Uptake.

d) BMD (Bone Mineral Densitometry) for early detection of osteoporosis/osteopenia and low bone mass.

d) At present there are four (04) Color Doppler's including two 4D, one two 3D machines. All sorts of diagnostic USG, including normal B-scan of different organs, HRUS of superficial organs and Color Doppler of the vascular system are routinely performed.

e) Hormone Analysis: By using the RIA and modern CLIA techniques the In-vitro division is estimating all thyroid-related hormones like T3, T4, TSH, FT3, FT4, LH, FSH, pituitary hormones, estrogen, progesterone, prolactin, testosterone, follicular stimulating and luteinizing hormones, vitamin D, parathormone, thyroglobulin, thyroid antibodies etc.

1.2 Therapeutic Activities

The therapeutic component of our activity is extensively in the treatment of thyroid cancer and hyperthyroid patients using I-131.

2. Arranged Training Program/Workshop/Seminar/Symposium/Conference

Sl. No.	Title	Date	Place	No. of participant
1.	Weekly Seminar	Every Tuesday	INMAS, Mohakhali	12
2.	Inauguration of PET-CT at INMAS, Mohakhali: Our Initial Experiences	31 January, 2023	INMAS, Mohakhali	30

3.	Management of Patients with Different Thyroid Carcinoma-National Guideline	28 May, 2024	INMAS, Mohakhali	30

3. Manpower Development (Training Attended)

Sl. No.	Name of the Participant	Title of the event	Organizer	Date	Place
1.	Dr. Sharmin Quddus CMO & Director	Clinical training of Dual Head SPECT Gamma Camera	Mediso Medical Imaging System Ltd.	17-30 November, 2023	Hungary
2.		Clinical Training of Thyroid Camera with Accessories	MIE medical imaging electronics	25 February 2024 -03 March, 2024	Germany
3.	Dr. Mohammad Iqbal Hossain SMO	Clinical training of Dual Head SPECT Scanner with Accessories	Mediso Medical Imaging System Ltd.	17-31 March, 2024	Hungary
4.	Mahbuba Zaman SO	Training of Automatic Radioimmunoassay (RIA) counter with liquid handling system	PerkinElmer Singapore Pte Ltd.	27 February 2024 -03 March, 2024	Delhi, India
5.	Dr. Arshad Hossain MO	mgmvgwqKwel†qKg©Pvix†`imÿgZvDb æq†bjvwbs †mkb	SID, BAEC,Dhaka	04September, 2023	BAEC,Dhaka
6.	Md. Jahir Alam SO	mgmvgwqKwel†qKg©Pvix†`imÿgZvDb æq†bjvwbs †mkb	SID, BAEC,Dhaka	04September, 2023	BAEC, Dhaka
7.		Training InstituteG Follow-up Training Course (FTC)Gi AvIZvqReactor Engineering Course-	TI, AERE	03 December 2023 -14 December, 2023	Savar
8.		“Training Course on Radiation Protection for Radiation Workers and RCO’s of BAEC, Medical Facilities & Industries”-	TI, AERE	02, June 2024 -06 June, 2024	Savar
9.	Pabitra Kumar Kundu AO	Training on Smart Office in alignment with Smart Bangladesh	BIM	28, April 2024 -09 May, 2024	Sobhanbag, Dhaka
10.		Awf†hvMcÖwZKvie“e”v I wRAviGmmdUIqviGes Z_” AwaKviAvBb	SID, BAEC,Dhaka	30, April 2024	BAEC, Dhaka

4. Attended in Seminar/Symposium/Conference/Workshop/Meeting

Name of Participants	Title of the event	Organizer	Date	Place
Dr. Sharmin Quddus Dr. Iqbal Hossain Dr. Rahima Akter Dr. Humayra Tasnim Dr. Arshad Hossain Md. Jahir Alam Mahbuba Zaman Dr. Nilufa Yasmin Md. Alamgir Kabir Md. Shahidul Islam Khan	Inauguration of PET-CT at INMAS, Mohakhali: Our Initial Experiences	INMAS, Mohakhali	31 January, 2023	INMAS, Mohakhali

Dr. Sharmin Quddus Dr. Iqbal Hossain Dr. Rahima Akter Dr. Humayra Tasnim Dr. Arshad Hossain Md. Jahir Alam Mahbuba Zaman Dr. Nilufa Yasmin Md. Alamgir Kabir Md. Shahidul Islam Khan	27 th SNMB Conference	Society of Nuclear Medicine, Bangladesh	08 March, 2023	Hotel Intercontinental, Dhaka
Dr. Sharmin Quddus Dr. Iqbal Hossain Dr. Rahima Sharmin Dr. Humayra Tasnim Dr. Arshad Hossain Dr. Nilufa Yasmin	35 th National Conference of Ultrasonography	The Bangladesh Society of Nuclear Ultrasonography	27-28 October, 2023	Pan Pacific Sonargaon, Dhaka

5. Others

Regular follow up for thyroid patients

6. Service Rendered and Revenue Income

Name of Service (Department wise)	No. of Patient/Sample	Income
1. BMD (Bone Mineral Density)	12	6,009,510.00
2. PET-CT Scan	190	
3. Gamma Camera	436	
4. General	55	
5. In-Vitro Lab	676	
6. Radio-iodine Therapy Unit	1	
7. Thyroid	43	
8. Ultrasound	564	

INSTITUTE OF NUCLEAR MEDICINE AND ALLIED SCIENCES (INMAS), JASHORE

Objective

Institute of Nuclear Medicine and Allied Sciences (INMAS), Jashore was established in 2023 under the “Establishment of 8 INMAS around the country” project with the supervision of BAEC. This institution is now fully operational with nuclear medicine and other facilities like SPECT-CT, CT scan, BMD, ultrasound, in-vitro laboratory, and others. It offers diagnostics like radionuclide and other imaging, biomarkers, hormone and blood tests as well as therapies including thyroid cancer treatment and follow-up. This institution is providing research and academic programs to advance nuclear medicine and related sciences across the nation.

2. Manpower Development(Training /Fellowship/ Workshop/Meeting)

2.1 Attended in training

Sl. No	Name of the Training	Date	Place	Number of participants
1	Clinical Training of Thyroid Camera with accessories with QA and QC Under the project of INMAS installation in 8 Medical College Hospital campus under BAEC	12 th January, 2023	INMAS, Mohakhali	1
2	Clinical Training of Dual Head Gamma Camera with accessories (Mediso Medical Imaging systems Ltd) Under the project of	15-18 th May, 2023	INMAS, Mohakhali	1

	INMAS installation in 8 Medical College Hospital campus under BAC			
3	Clinical Training of Dual Head Gamma Camera with accessories (Siemens Healthcare Ltd) Under the project of INMAS installation in 8 Medical College Hospital campus under BAEC	4 th April, 2023	INMAS, Mohakhali	1
4	Clinical Training of Dual Head SPECT Scanner with accessories at Mediso Medical Imaging Systems	17-31 March 2024	Hungary	1
5	Advanced Doppler ultrasonography by Bangladesh Society of Ultrasonography	15 th July, 2023	Bangladesh Society of Ultrasonography Auditorium, Eastern Plaza, Dhaka	1
6	Taining on 4D color Doppler and ultrasound	19-25 August	Tokyo, Japan	1
7	Clinical Training Course	17-28 th Dec, 2023	INMAS, Khulna	1
8	Training of 4D product and application of Color Doppler	15- 23 th July, 2024	Noida, India	1
9	Training Course on Radiation Protection For Radiation Workers & RCOs Of BAEC, Medical Facilities & Industries	02-06 June, 2024	Training Institute, Savar	1
10	Reactor Engineering course at BAEC	03-14 December, 2023	Training Institute, Savar	1

3. Attended in Seminar/Symposium/Conference(National and International)

Name of the Participant	Title of the event	Organizer	Date	Place	Number of participants
Dr. Md. Jamiul Hossain, Md Asraful Alam	6 th National Conference and Annual General Meeting	Bangladesh Thyroid Society	20 October, 2023	Ball Room, Pan Pacific Sonargaon Hotel	2
Dr. Md. Jamiul Hossain, Dr. Tuba Ul Jannat Mou, Md Asraful Alam, Dr. Md Shohagh Hossain	27 th National Conference of Society of Nuclear Medicine	Society of Nuclear Medicine, Bangladesh	2024	Hotel Intercontinental	4

4. Stakeholder Meeting

Sl. No	Title of the program	Date	Place	Number of participants
01	Scientific Seminar on Current Nuclear Medicine Status in Bangladesh & Available facilities at INMAS, Jashore	10 th June, 2024	INMAS Multipurpose Hall, Jashore	100

5. Service Rendered

Sl No.	Name of service provided	number/quantity of sample/patient / service	revenue income (taka)
01	BMD (Bone Mineral Density)	29	46,000
02	CT Scan	9	9600
03	Gamma Camera	120	118,000
04	General	226	110,300
05	In-vitro lab	858	579,450
06	Thyroid	225	143,200
07	Ultrasound	462	218,400

Discount			9910
Refund (Due to patient declination)			10350
Total		1444	1,204,690
6Total	90.00	85.48	

INSTITUTE OF NUCLEAR MEDICINE AND ALLIED SCIENCES (INMAS), GOPALGANJ

Objective

Operate as a sustainable one stop, point of care for global standard nuclear medicine and allied procedures/services to the people hailing from the catchment area.

- Establish a support system for the major local hospitals by providing adequate information about the services available and by delivering global standard nuclear medicine and allied procedures/services according to their requirement.
- Ensure availability of nuclear medicine and allied procedures/services according to the requirement of major hospitals in neighboring districts and disseminate adequate information about the procedure/services in order to emerge as a sustainable support to the older and busier INMASes in the southern region during their frequently occurring overflowing of schedules.
- Establishment of শুদ্ধাচার অনুশীলন that will in turn facilitate best possible ambience in all possible aspects towards the service seeking people throughout their stay within the premises of INMAS Gopalganj.
- Foster a congenial working environment and implement a healthy work culture within the INMAS, Gopalganj.
- Ensure best and wastage free utilization of resources by administering regular servicing, quality control and appropriate operation of the state-of-the-art laboratory equipment and vigilant combat against the adverse maintenance conditions.
- Ensure regular training and education of the personnel working in the INMAS Gopalganj in order to keep their scientific knowledge and skills up to the mark.
- Continuous effort and research to improve the existing service delivery system both independently as well as through collaborative venture with science and technology universities.
- Conduct research of global standard using the patient data collected and generated during nuclear medicine and allied services in order to deepen the existing understanding about diseases and their management both independently as well as through collaboration with medical colleges and hospitals.
- Evolve into a center of excellence for education and training of medical technologists, nurses, physicists, chemists and physicians who work or look forward to work in the field of nuclear medicine and allied sciences.
- Ensure radiation safety practices in adherence to the guidelines from local regulatory authorities and international agencies.

Activities

1. R&D work(s)

- Evaluation of thyroid hormones and ultrasonographic features in health and diseases.
- Evaluation of ultrasonographic features of ovaries during derangement of sex hormone levels.
- Evaluation of ultrasonographic features of testes in male infertility.
- Evaluation of renal arterial velocimetric indices in middle aged and elderly people in health and diseases.
- Assessment of interrelation among DXA whole body composition, ultrasonographic measures of body fat content and anthropometric parameters.

2. Manpower Development(Training Program/Workshop/Seminar/Symposium/Conference)

Sl. No	Title	Date	Place	No. of participants
a)	Environmental Radioactivity Monitoring Course at BAEC (ERMC-11)"	29.10.2023-02.11.2023	TI, AERE	02
b)	``Reactor Engineering Course at BAEC (RECB-11)-2023"	03-14.12.2023	TI, AERE	02
c)	Training in PPR-2008 & public procurement management 2024	28.01.2024-08.02.2024	TI, AERE	02
d)	Training Course on Radiation Protection for Radiation Workers and RCOs of BAEC, Medical Facilities and Industries-2024	02.06.2024-06.06.2024	TI, AERE	02

3. Academic Activities:

- Weekly sessions for medical and scientific officers for widening their knowledge in nuclear medicine and allied sciences, and health research.
- Weekly sessions for hands-on training and read with expert for the development of clinical skills among the medical officers.
- Day-long seminar and laboratory visit for the intern doctors from Sheikh Sayera Khatun Medical College for their introduction to nuclear medicine and allied health care services.

4. Service Rendered

Number of Patients	Income (BDT)
7050	39,79,960/-

INSTITUTE OF NUCLEAR MEDICINE AND ALLIED SCIENCES (INMAS), SATKHIRA**Objective**

- To facilitate peaceful application of nuclear medicine & radiation technology according to aims & objectives of BAEC.
- Provide excellent diagnostic and therapeutic services to patients using nuclear technology.
- To promote better understanding of nuclear medicine & radiation services among the medical professionals

To facilitate research and development works in the relevant fields of nuclear medicine.

Programme(s)**1. R&D work(s)**

- Biochemical & hormonal outcomes of personnel exposed to radio-isotopeworking in a nuclear medicine facility.
- Estimation of PSV at trigeminal artery of patients associated with headache resistant to conservative treatment.
- Evaluation of outcome of tubal inflation/irrigation following SIS.

2. Manpower Development

Sl. No	Title (Training program/ Workshop/ Seminar/ Symposium/ Conference)	Date	Place	No. of participant

a)	Nuclear and radiological emergency preparedness course at BAEC-2023	10-21.09.2023	TI, AERE	02
b)	Environmental Radioactivity Monitoring Course at BAEC (ERMC-11)"	29.10.2023-02.11.2023	TI, AERE	01
c)	Reactor Engineering Course at BAEC (RECB-11)-2023"	03-14.12.2023	TI, AERE	01
d)	Training in PPR-2008 & public procurement management 2024	28.01.2024-08.02.2024	TI, AERE	01

3. Attended in Seminar/Symposium/Conference/Workshop/Meeting

Name of the participant	Title of the event	Organizer	Date	Place
a) Dr. Tasmia Shahid & Dr. Mehnaz Riffat	27 TH Annual conference of Society of Nuclear Medicine. Bangladesh.	Society of Nuclear Medicine, Bangladesh	27.03.2024	Dhaka

4. Academic Activities

- Undergraduate students of Satkhira Medical College received training on DTPA renogram
- Arranged Seminar on Nuclear Medicine, Ultrasound procedures and related subjects monthly.
- To provide six (06) months honorary training on Nuclear Medicine & Ultrasound.

5. Service Rendered

Number of Patients	Income (BDT)
3,343	22,94,000/-

INSTITUTE OF NUCLEAR MEDICINE AND ALLIED SCIENCES (INMAS), PABNA

Objective/Introduction

- To facilitate peaceful application of nuclear medicine & radiation technology according to aims & objectives of BAEC.
- Provide excellent diagnostic and therapeutic services to patients using nuclear technology.
- To promote better understanding of nuclear medicine & radiation services among the medical professionals
- To simplify research and development works in the relevant fields of nuclear medicine.
- To develop the Human resources.

Activities/Program(s)

1. R&D work(s)

- Biochemical & hormonal outcomes of personnel exposed to radio-isotope working in a nuclear medicine facility.
- Estimation of PSV at trigeminal artery of patient associated with headache resistant to conservative treatment.
- Evaluation of outcome of tubal inflation/irrigation following SIS.

2. Manpower Development

2.1 Attended in Intraining/ Fellowship/ Workshop/ Meeting (Training program/ Workshop/ Seminar/ Symposium/ Conference)

Sl. No	Title	Date	Place	No. of participant

1.	Clinical Training of Dual Head SPECT Gamma Camera at Mediso Medical Imaging Systems Ltd	17.11.23-30.11.23, 17.03.24-31.03.24 & 24.06.24-05.07.24	Hungary	03
2.	Clinical Training & Service Training of Thyroid Camera with Accessories at MIE medical imaging electronics GmbH	26.02.24-03.03.24	Germany	01
3.	Training of 4D High Resolution Color Doppler	24.06.24-30.06.24	Japan	01
4.	Training of BMD with accessories in Nimes France	22.07.24-28.07.24	France	01
5.	A Training Course on "Radiation Protection for Radiation Workers and RCOs of BAEC, Medical Facilities & Industries-2024"	02.06.24-07.06.24	TI, AERE	02

3. Attended in Seminar/Symposium/Conference/Workshop/Meeting

Name of the participant	Title of the event	Organizer	Date	Place
1. Dr. Md. Mosharruf Hossain 2. Dr. Fahim Uddin Ahmad 3. Dr. Sanzida Parvin 4. Dr. Md. Afraem Hossain Seam 5. Md. Rubel Alamin 6. Pronoy Ghosh	27 TH Annual conference of Society of Nuclear Medicine, Bangladesh.	Society of Nuclear Medicine, Bangladesh	27.03.2024	Dhaka

Service Rendered (October, 2023-June, 2024)

Number of Patients	Income (BDT)
1833	1285,870/-

INSTITUTE OF NUCLEAR MEDICINE AND ALLIED SCIENCES (INMAS), KUSHTIA

Objective

- To assure modernized and specialized medical services to the people using latest nuclear technology
- To improve and upgrade nuclear medicine facility in Bangladesh
- To conduct training of physicians, physicists, radio-pharmacists and technologists in the field of nuclear medicine
- To conduct updated academic and research activities
- To coordinate and standardize

1. R&D work(s)

1.1 Pregnancy Outcome and Health Status of the Offspring of Differentiated Thyroid Cancer Patients, Who Accidentally Conceived Within Two Years of Radioiodine Ablation Therapy

Md. Sunny Anam Chowdhury, Sujon Mahmud, Fariha Jerin, Yeasmin Akter, Bahlul Hasan, Md. Abdul Awal, Suraya Sarmin, Md. Al Mamun, Md. Faruk Hossain, Nazia Tarannum, Md. Sifat Meftaul Jannat

The research work was performed in collaboration with INMAS Bogura, to assess the pregnancy outcome and health status of the offspring of 17 women of differentiated thyroid cancer conceived within 2 years of RAI therapy and compared to the outcome and health status of the offspring of 10 healthy pregnant woman of same age group without any thyroid disorder. One (5.9%) of 17 patients had preeclampsia and two (11.7%) showed preterm labour, which was not significant and not dependent on the therapeutic dose of I-131 or time interval. The mean birth weight and birth length of the children in the study cases were significantly lower compared to the children of control group. No congenital anomaly, abnormal thyroid hormone level and sonographically detectable thyroid abnormality were found. The normal neuropsychomotor development of the children and good school performance were assured. No case of miscarriage, stillbirth or neonatal death was observed. All the children were healthy.

Although radioiodine therapy showed no significant effect on pregnancy outcomes or health status of offspring, precaution should be taken to avoid risky pregnancy. And patients should be encouraged to conceive after an adequate time interval after therapy.

1.2 Workplace Radiation Monitoring And Analysis: A single Institution-Based Study

Md. Faruk Hossain, Md. Sunny Anam Chowdhury, Md. Abdul Awal, Md. Monirul Haque, Suraya Sarmin, Md. Al Mamun, Nazia Tarannum

The research work was performed in collaboration with INMAS Bogura, with three folds primary objectives: first, to assess radiation exposure level within a nuclear medicine institute; second, to identify and address potential risks associated with diagnostic and therapeutic procedures; and finally, to establish strong control measures and emergency response plans. These goals collectively aim to contribute to the creation of a personalized radiation protection program that addresses the unique issues provided by nuclear medicine applications. Continuous radiation surveys over six months identified maximum values in specific areas within the institution, such as SPECT room and therapy room, all below the allowable limit, which ensure the safety of personnel and patients while maintaining ambient radiation level s outside the institution consistently below the permissible limit. This study provided essential data for establishing a dose reduction strategy in a clinical NM facility, confirming INMAS Bogura as free from radiation induced risks and emphasizing the importance of continuous evaluation, adherence to regulations, long term monitoring to ensure safe radiological working conditions.

1.3 Early Miscarriage of Unwanted Pregnancy after Radioiodine Ablation in a Patient With Graves' Disease

Fariha Zerin, Sujon Mahmud, Md. Sifat Maftaul Jannat, Yeasmin Akter, Bahalul Hasan, Md. Sunny Anam Chowdhury

Graves' disease in females of childbearing age is common. Radioiodine therapy is a definitive treatment for such a condition. The effect of radiation on germ cells and iatrogenic hypothyroidism following radioiodine therapy may cause a bad pregnancy outcome. This research work shows unfortunate case of miscarriage of early pregnancy following a short period after RAI therapy and an approach to the clinical question "how to manage Graves' disease with RAI therapy in women of childbearing potential". Maintenance of an adequate interval and achieving euthyroid state after RAI therapy in Graves' disease in patients willing to conceive can reduce the risk of miscarriage and assure a good pregnancy outcome.

2. Manpower development

2.1 Attended in training

Sl. No.	Title of the program	Date	Place	Number of Participants
1.	Clinical and service training of thyroid camera with accessories	26/02/2024-03/03/2024	Hamburg, Germany	01
2.	Clinical training on Dual head SPECT gamma camera	17/11/2023-30/11/2023	Hungary	01
3.	Clinical training on Dual head SPECT gamma camera	18/03/2024-28/03/2024	Hungary	01
4.	Training on in vitro lab	12/10/2023-25/10/2023	NINMAS	02
5.	Training on in vitro lab and scintigraphy	14/10/2023-27/10/2023	INMAS, Rajshahi	02
6.	Training on thyroid camera	20/09/2023	INMAS, Mohakhali	02
7.	Training on Mediso SPECT	14/08/2023-15/08/2023	INMAS, Mohakhali	02
8.	Training on SIEMENS SPECT-CT	04/01/2024-05/01/2024	INMAS, Mohakhali	02
9.	IBAS++	07/10/2023-08/10/2023	Poromanu Bhaban, Dhaka	01
10.	PPR	28/01/2024-08/02/2024	TI, AERE, Savar	01
11.	Radiation Protection (RCO)	02/06/2024-06/06/2024	TI, AERE, Savar	01
12.	Nuclear & Radiological Emergency Preparedness	10/09/2023-21/09/2023	TI, AERE, Savar	03

3. Organize Meeting

Sl. No.	Title of the program	Date	Place	Number of participants
1.	National integrity strategy	20/08/2023	INMAS Kushtia	28
2.	National integrity strategy	18/11/2023	INMAS Kushtia	26
3.	Radiation protection and emergency radiation measures	16/02/2024	INMAS Kushtia	26
4.	National integrity strategy	12/03/2024	INMAS Kushtia	29

4. Stakeholder Meeting

Sl. No.	Title of the program	Date	Place	Number of participants
a.	Services of INMAS Kushtia	22/10/2023	INMAS Kushtia	18
b.	Online appointment system in INMAS Kushtia	18/04/2024	INMAS Kushtia	22

4. Service Rendered

Sl No.	Name of service provided	Number of patients	Revenue income (BDT)
1	BMD	4	6000/-
2	Whole body scan	8	9400/-
3	Scintigraphy	36	36000/-
4	Thyroid clinic	365	116100/-
5	In Vitro lab	1846	1043400/-
6	Thyroid facility	54	44100/-
7	Ultrasonography	1027	418800/-

III. ENGINEERING AND GENERAL SERVICES**ENGINEERING DIVISION (ED), BAEC HQ**

Bangladesh Atomic Energy Commission has been engaged in research and development (R & D) activities in the various fields of Nuclear Science and Technology in the country. The Engineering Division (ED) is formed under approved charters of BAEC (e.g., Enam Committee, BAEC Perspective Plan-1993-2010 and BAEC service rules & orders) as a main integral organ for conducting appropriate engineering and technological research to design and develop sustainable technologies and facilities to solve the upcoming engineering problems for promoting overall BAEC's research activities in the field of nuclear science and technology in the country. Currently under the some Charters of Bangladesh Atomic Energy Commission, Engineering Division (ED) has been entrusted with the responsibilities for planning, designing, fabrication, installation, operation and supervision of various scientific, nuclear and engineering infrastructures, facilities and accomplishing of routine repair & maintenance works for smooth operation of overall R&D programs of BAEC under both revenue and ADP budget along with limited related technological research activities with the resources it has. This division is also responsible for procurement of works/goods/services by bidding national and international tender as per PPR-2008 for creating above facilities and required technical services. Thus, this division is performing the key role for implementing the overall R&D for promoting nuclear science and technology and its peaceful applications in the country.

1. Contribution in implementation of various ADP projects of BAEC(ongoing)

- Works contributing under the project "Establishment of Water Supply Facilities at Rooppur Nuclear Power Plant Site Office."
- Works contributed under the project "Establishment of Positron Emission Tomography-Computed Tomography (PET-CT) with Cyclotron facilities" at Mymensingh and Chittagong.

- c. Works contributed under the project “Establishment of Positron Emission Tomography–Computed Tomography (PET-CT) with Cyclotron facilities” at AERE, Savar.
- d. Works contributed under the project “Enhance Capacity of Institute of Nuclear Medicine and Allied Sciences (INMAS) at Mitford, Comilla, Faridpur, Barisal and Bagura.”
- e. Works contributed under the project “Establishment of Institute of Nano Technology” at AERE, Savar.
- f. Works contributed under the project “Establishment of Genome Sequencing Facilities.” at INMAS Dhaka and Chittagong.
- g. Works contributed under the at Iswardi, Pabna.
- h. Similar works contributed for the project “Balancing, Modernization, Refurbishment and Extension (BMRE) of Safety Systems of the 3 MW TRIGA Mark-II Research Reactor Facilities”.
- i. Strengthening of existing gamma source of Bangladesh Atomic Energy Commission.
- j. Modernization and Strengthening of Services and Research Facilities of the Institute of Tissue Banking and Biomaterial Research.
- k. Modernization of Laboratories and Enhancement of Service Capacity of 3 Divisions (Chemistry Division, Health Physics Division, Experimental Physics Division) of Atomic Energy Centre, Dhaka.

2. Contribution in implementation of various ADP projects of BAEC (Completed)

- a. Works contributing under the project “Establishment of Institute of Nuclear Medicine and Allied Sciences (INMAS) at 8 Medical Collage Hospital Campuses in the country “at Dhaka, Khustia, Jessore, Cox’s Bazar, Gopalganj, Pabna, Satkhirah.
 - Works for Planning, Designing, Estimating and Construction of eight new buildings under the project.
 - Supervision of all new INMAS buildings.
 - Civil construction management and other related mechanical, electrical works done for installation of Sub-Stations, Lifts, AC, Pumps etc.
- b. Works contributing under the project “Enhance Capacity of Institute of Nuclear Medicine and Allied Sciences (INMAS) at Dhaka, Chittagong, Khulna, Sylhet, Rajshahi, Dinajpur and Rangpur “are as follows:
 - Planning, designing, estimating and supervision of renovation works of old INMAS buildings.
 - Construction of six storied new building in Dinajpur, three storied in Khulna and Rajshahi, one storied in Chittagong and also vertical extension in Rangpur.
 - Construction and installation of lift, AC, Sub-station are in progress.
 - Construction of new gate and guard room at INMAS Dhaka.
 - Construction and supervision of auditorium buildings under the project.
- c. Works contributed for planning, designing, estimating and construction of Three Storied new residential building under the project “Development of Human Resources & Establishment of Residential Accommodation Facilities for the Radiation Testing and Monitoring Laboratory”, at Mongla.
- d. Works for Planning, Designing, Estimating and Construction of new radiotherapy facilities under the project “Establishment of Calibration and Quality Control Facilities for Radiotherapy, Diagnostic Radiology and Neutron”.
- e. Works contributed under the project “Capacity build-up of Nano and Nanobio-Technological laboratory” at Material Science Division, AEC, Dhaka are as follows:
 - Planning, designing and estimation for renovation of laboratories of Material Science division at AECD.
 - Installation, testing and commissioning of Air Conditioning system and other related mechanical and electrical works.

f. Works contributed under the project “Establishment of Positron Emission Tomography–Computed Tomography (PET-CT) with Cyclotron facilities” at AERE, Savar are as follows: -

- Installation, testing and commissioning of 1000KVA new Sub-station.
- Installation, testing and commissioning of 300KVA generator and other related electrical and mechanical works.

g. Similar works contributed for the project “Balancing, Modernization, Refurbishment and Extension (BMRE) of Safe

h. ty Systems of the 3 MW TRIGA Mark-II Research Reactor Facilities”.

i. Similar works contributed for the project “Establishment of Cyclotron & PET-CT at Institute of Nuclear Medicine & Allied Sciences (INMAS) Mymensingh & Chittagong and Cyclotron facilities at Institute of Nuclear Medical Physics (INMP), Savar”

j. Similar works contributed for the project “Establishment of Calibration and Quality Control Facilities for Radiotherapy, Diagnostic Radiology and Neutron”.

3. Works accomplished by Engineering Division in (2023-2024) under Revenue Budget

Engineering Division is one of the most important divisions of this organization, as it responsible to smoothly operate the overall R&D activities of BAEC by creating various facilities, work and services within the financial year 2023-2024 are given below:

4. At BAEC HQ, Dhaka

- Supply, Installation, Commissioning & Testing of Video Conference system, Sound Control System and Related works at BETA Conference Hall. Canteen Bhaban, Agargaon, Dhaka.
- Annual Maintenance of two Lifts (1250 Kg & 630 Kg) at ParamanuBhaban, BAEC, HQ, Dhaka.
- Repair and servicing of Air Conditioner at Conference Center, BAEC, HQ.
- Electrical Maintenance Equipment for BAEC, HQ, Dhaka.
- Renovation/Repair & Maintenance work with Supply of Furniture for Canteen (Ground & First Floor) at Canteen Building, BAEC, HQ, DHAKA.
- Supply, installation, testing & commissioning for internet system equipment and other related work at BAEC, BAEC, Head Quarter, Agargaon, Dhaka.
- Supply and Installation of Reverse Osmosis system water purifier at BAEC, Head Quarter. Dhaka.
- Supply, installation, testing and commissioning of security light for HQ, BAEC, Dhaka.
- Replacement of Condensing Unit of 1.5 Ton Split Type AC at BAEC, HQ.
- Repair/maintenance works of Dr. Anwar Hossain Auditorium at BAEC, Head Quarter, Dhaka.
- Supply, Installation, Testing and Commissioning of Air Conditioner at Director's room, Bio Science Division.
- Supplying, Fitting and Fixing of Furniture for Chairman's office Room of BAEC, HQ, Dhaka.
- Repair, Maintenance and Modification work of former committee room #301 and chairman office room at BAEC, HQ.
- Repair and Maintenance works of Washroom at Planning Division, BAEC, Head Quarter.
- Supply of Dining Table and chair for Canteen Bhaban at BAEC, HQ, Agargaon, Dhaka.

4. At RNPP SITE

- Aluminum Structure, Digital Panel, Furniture, Fence Outside & Inside Branding Works for the Graduation Ceremony of Rooppur Nuclear Power Plant site Ishwardi, Pabna (Lot-1).
- Invitation card, jute bag, pen, note pad, booklet, dinner card, design of supplement & audio visual, food, networking broadband rental, vehicle rent and other related works for the Graduation Ceremony of Rooppur Nuclear Power Plant site Ishwardi, Pabna.

5. At BAEC Housing Colony, Banani, Dhaka

- Repair-Maintenance with necessary Modification of Flat No C-17, D-03, D-07, D-11 & Annex-02 at BAEC, Housing Colony, Banani, Dhaka.
- Supply, Installation, testing and commissioning of Air Cooler at BAEC, Housing Colony, Banani, Dhaka. (Lot-03).

- Repair works of dining Room (Guest House) and Electrical works (security Light & Flat No C-1) at BAEC, Housing Colony, Dhaka.
- Repair and maintenance work of Flat no c-6 at BAEC, Housing Colony, Banani, Dhaka.
- Repair and Maintenance works of Flat no: C-14, D-09, HB-02, HB-03 & HB-06 at BAEC, Housing Colony, Banani, Dhaka.
- Cleaning of night soil and waste from septic tank, inspection pit and sewers from BAEC housing society sewerage network.
- Supply, Installation, Testing and commissioning of Refrigerator and chest freezer at BAEC, Housing Guest House, Banani, Dhaka.

6. At AERE and Othercampus of BAEC

- Supply, Installation, Testing and Commissioning of Split Type Air Cooler at BSMEC Guest House, Cox's Bazar.
- Stall Preparation and Decoration of Bangladesh Atomic Energy Commission in Amar Ekushey Book Fair-2024 at Bangla Academy Campus, Dhaka.

7. At NINMAS & INMAS

- Supply installation, testing and commissioning of air cooler in lift machine room at NINMAS, Shabag, Dhaka.
- Even Management for the inspiration of institute of Nuclear Medicine and Allied Sciences (INMAS) Project (Eight Medical College Campus) by the Honorable Prime Minister Sheikh Hasina at INMAS, Satkhira.
- Fabrication, Fitting, Fixing and Testing of Flood Barrier in front of Room Doors and Toilet Doors on the Ground Floor at INMAS, Sylhet.

8. Some completed services within the financial year 2023-2024 are given below

Engineering Division is one of the key divisions of this organization, as it responsible to smoothly operate the overall R&D activities of BAEC by creating various facilities, work and services. Some services within the financial year 2021-2022 are given below:

- Works contributing under the project “Enhance Capacity of Institute of Nuclear Medicine and Allied Sciences (INMAS) at Dhaka, Chittagong, Khulna, Sylhet, Rajshahi, Dinajpur and Rangpur”.
- Works contributing under the project “Modernization of Food and Radiation Biology Facilities” AERE, Savar.
- Works contributed under the project “Capacity build-up of Nano and Nano-bio-Technological laboratory” at Material Science Division, AEC, Dhaka.
- Providing technical expert services in various Centers/institutes/different projects of BAEC and other National Projects outside BAEC like
 - a. Department of Environment.
 - b. Science Museum.

9. Manpower Development

Sl. No.	Title	Date	Place	No. of participant
01	“Innovative Idea Development for Smart Bangladesh.”	11/06/2024	Alpha Hall, BAEC, HQ.	1
02	“Training Course on PPR-2008 and Public Procurement Management-2024.”	25-01-2024	Training Institute, AERE, Savar.	1
03	“Learning Session for CapacityBuildup of officers.”	24/08/2023	Alpha Hall, BAEC, HQ	2
04	“Learning Session for D-Nothi Development.”	11/12/2023	Alpha Hall, BAEC, HQ	2

10. Preparationof Development Project Pro-forma (DPP) in 2024-2025

This division is also responsible for estimation and preparation of DPP of various government ADP projects under BAEC. Some similar ADP projects are given below:

- “Construction of New Residential Buildings and Infrastructure Development of Existing Residential Area of Bangladesh Atomic Energy Commission”.

ENGINEERING AND GERNERAL SERVICE DIVISION, AECD

Engineering and General Service Division is providing engineering and technical services to research and development activities in the Atomic Energy Centre, Dhaka. This division has five sections: Electrical, Refrigeration & Air Conditioning System, Plumbing, Workshop and Glass Blowing section. These sections support technical and divisional activities of all divisions in AEC, Dhaka including the RNPP office located on this campus. This division also provides all utility services such as Electricity, Water supply, Ventilation, Air-conditioning (AC) Systems; Civil works etc. through the respective sections. A brief description of services provided are:

During the reporting period (01 July 2023 – 30 June 2024) this division received over 105 jobs requisition from different divisions of AECD, RNPP, and BAEC HQ.

1. ELECTRICAL SECTION: During this period electrical section has completed 27 jobs in AECD.

1.1 The electrical section has done various jobs in this reporting period for AECD including-

- Repair and maintenance of SDB board replacement of cable in the Health Physics Division.
- Preparing the electrical line for installation of AC in the Clinic section in AEC, Dhaka.
- Repair the Fan and electrical line in the Accounts section.
- Repair and replace tube lights in the Scientist sitting room.
- Installation of various Tube lights in the preparing line according to the load in the Electronics lab
- Repair and installation of Tube light in the synthesis lab.
- Repair Split type AC power and Light in ACL, Trace Analysis Lab.
- Fume Hood fan repair and fixed in Chemistry lab.
- Installation of AC in theScientist sitting room.
- Repair AC power and circuit breaker in the Chemistry lab.
- Repair and installation of exhaust fan in the AEC, Canteen, Dhaka.
- Repair and maintenance of light and combined sockets in the Health Physics division.
- Repair an Electrical circuit in the Health Physics division
- Fixing the Light and Energy bulb in the NDT division.
- Installation of UPS with the existing load in MSD Lab.

2. REFRIGERATION & AIR-CONDITIONING SYSTEM SECTION: During the period, this section has completed 40 jobs including-

- Repair and maintenance of AC in the Experimental Physics and NDT Division.
- A total of 03 AC were repaired (i.e. gas charge, circuit, compressor, blower etc) for Library Section.
- AC was repaired in the Server Room in AEC, Dhaka.
- Repair and annual maintenance of 10 number of AC in the Health Physics Division.
- Two AC were repaired in the Scientist Sitting Room.
- Three AC were repaired and serviced in XRD Lab, Material Science division (MSD).
- Fixing the problem of the AC in the Director’s Room in AEC and repairing it.
- Split type 09 AC repaired and annual servicing in the Electronics Division.
- Repair and fix 2 AC in Administration Section in AEC, Dhaka.

3. PLUMBING SECTION: During the session, the plumbing section completed 35 jobs including-

- A new submersible pump is installed in AECD. Dhaka.
- Repair and maintenance of the water supply line at the Material ScienceDivision(MSD) in AEC, Dhaka.
- Maintenance and repair work of male washroom of the second floor, Store building and NDT Division. there are 6 number of Basin and Water taps that were repaired in different establishment in AEC, Dhaka.

- Repair and maintenance of water tanks of the Director's room and toilet flush mended at the head of the NDT Division.
- Solved the problem of water leakage from the pipe at the Scientist room in the NDT Division.
- Installed the 2 basin at the AFD Division and repair the water tap at the Synthesis Lab.
- Established the water pipe at the Material Science Division (MSD).
- Installed the water basin at the NDT and the Material Science Division (MSD).
- Repaired and Maintenance of the water supply pipe at the AFD Division.
- The Basin tap was repaired at MSD and the water pump repair was fixed for Electronics division.

4. WORKSHOP SECTION: During the reporting period this Division performed 04 jobs

requisition and completed all the works successfully.

- Construct Metal body pot for MSD Lab.
- Made hole and bent MS pipe according to sample in RAC section.
- Made a solid Iron rod pusher for the Administration section.
- Installed door lock for E& GS.

5. GLASS BLOWING SECTION: During the mentioned period, this section has performed

6 glass-related works for AERE, a research student from Jahangirnagar University and Chemistry division.

CENTRAL ENGINEERING FACILITIES(CEF), AERE

CEF mainly works in construction of infrastructures and installation, repair & maintenance of the necessary equipments as well as providing the different services within Atomic Energy Research Establishment (AERE).

The fundamental works of CEF are to help all the institutions of AERE to carry out various sorts of R&D work by providing essential technical supports. It has been taking care of the engineering facilities within AERE campus as per requirements. CEF takes the responsibility of formulating all engineering related jobs like as designing, planning, installation, operation and maintenance of all facilities of AERE, the largest research complex of Bangladesh Atomic Energy Commission (BAEC). Electrical power supply system, gas supply system, water supply system, air conditioning system civil and sanitation system of AERE are the prime concern of CEF. In essence, it provides services in designing, development, construction, technical support, implementation and maintenance of the infrastructures developed at AERE. CEF also provide industrial attachment program, student of polytechnic and vocational training institute of Bangladesh.

Activities

1. Construction, Repair, Maintenance, Operation and Renovation Works

1.1 Mechanical Engineering Division, CEF

Major activities of the mechanical engineering division are given below:

- Supply drinking water which is used in different Institute of the office side and residential area of AERE colony.
- Repair, maintenance & replacement works of conceal stop cock, basin mixture pillar cock and tiles of VIP bath room no-2 of guest at AERE.
- Repair, maintenance & installation works of conceal bath room mixture, pillar cock, bibcock, lowdown flash, looking glass, soap case etc. bath room of training institute at AERE.
- Installation of new 1000 liter water tank on the roof of police camp at AERE
- Installation and servicing works of 1600mm x 150mm deep tube well with new column pipe and others materials at AERE colony.
- Installation of 1500 liter capacity new water tank on rooftop of officer's dormitory at AERE residential colony.
- Installation water line of RIPD kit production facilities of INST at AERE.
- Installation new circuit breaker of colony pumps 3D at AERE residential area.

- Repair & maintenance works of sink conceal stop cock, sink waste etc. of Gamma dosimeters laboratory of IFRB at AERE.
- Installed new 6" gate valve with modification for water line of office submersible pump at AERE.
- Repair & maintenance works of natural gas line of E₃, F₂, C₃ building, officer's, staff hostel guest house and central cafeteria at AERE.
- Replacement works of gas burner of E_{2/7}, C_{1/4}, F_{1/18}, F_{2/4}, D_{1/3} building, 306,405,401 nos. dormitory unit and answer shed at AERE colony.
- Replacement works of commode, basin and CI trap of C_{2/2}, F_{1/9} and E_{1/4}, E_{2/5} building at AERE colony.
- Repair & maintenance works of water line of SIU and MII division room no 213,214 at IFRB.
- Installation of new 1000 liter water tank on the roof of police camp at AERE
- Repair, maintenance, cleaning & replacement works of 6 nos. wash room, 17 nos. inspection pet, safety tank, sewerage line etc. of VIP guest house at AERE.
- Repair & maintenance works of 2HP submersible water pump of police camp at AERE campus
- Installation of new 1500 liter water tank on the roof of officer's dormitory at AERE colony.
- Replace of damage water heater from VIP guest house of room no -2 and installed new 30 liter automatic electric water heater with modification of existing water line.
- Repair & maintenance works and replacement of damage gas burner and installed new gas burner from different residential building at AERE. Approximately 25 nos. gas burner repaired and new installed 30 nos.
- Repair & maintenance works of natural gas line and gas regulator, lock wing cock, gas meter (4 nos.) Uzala key etc. as per requirement of different user at AERE.
- Repair colony side 25 HP centrifugal pumps 3D, 3A & 3C.
- Replacement of electric motor for colony pumps 3B.
- Repair office side 30 HP centrifugal pumps 2B.
- Repair maintenance and modification works of electric motor of office side pump 2A.
- Installation & modification works of ball cock for overhead water tank of office and colony building at AERE, Saver.
- Repair of underground water pipe line in front of F₁, E₂, D₁ building at AERE residential Area.
- Installation and refilling works of fire extinguisher at AERE office and colony.
- Check the gas regulator reading and gas bill at AERE office and colony.
- Prepare the monthly water bill of Uttara Bank Ltd.
- Painting works has done as per requirement of different institute.
- Design, estimate, purchase and implementation of different mechanical works as per requirement.
- Repair & maintenance works and check of sewerage line at AERE office and colony.
- Replace & maintenance work has done of the gas regulator and lock wing cock at AERE campus.
- Replace and installation works of basin, bibcock, pillar cock, sink, looking glass, glass self, moving shower and low-down set of different institute of office side and residential building at AERE colony.
- Replace and installation works of mechanical ball cock of C₁, F₁, E₁, CEF, IRPT building at AERE
- Routine mechanical maintenance works has done as per requirements of different institute at AERE campus

1.2 Electrical Engineering Division

- Repair, maintenance and installation works of 35 nos. building security light in AERE office and residential colony at AERE
- Repair, maintenance and installation works of 25 nos. street light in AERE office and residential colony at AERE
- Supervision works of installation 3 nos. tube light of corridor of radioisotope production division, INST at AERE.
- Electrical connection works of tube light of isotope hydrology division of INST at AERE.
- Repair & maintenance with necessary modification works of combined socket and switchboard insect biotechnology division of IFRB (room no. M- 208, M- 209) at AERE

- Repair and maintenance works of main distribution board of all institute and residential colony at AERE.
- Supervision of repair & maintenance with necessary modification works of nuclear and radiation chemistry division laboratory (room no.213) of INST at AERE.
- Installation of circuit breaker & power socket of VIP guest house at AERE
- Supervision of repair & maintenance works with necessary modification of two laboratories in plant biotechnology and genetic engineering division of FRB at AERE.
- Installation of 08 nos. new LED panel light of isotope hydrology division, reactor and neutron physics division, nuclear and radiation chemistry division-INST, food safety and quality analysis division, plant biotechnology and genetic engineering division-IFRB at AERE.
- Supervision works of repair and modification of the sitting room of head CFD at AERE.
- Routine repair and maintenance of laboratory instrument installation and power supply connection in food safety and quality analysis division, insect biotechnology division, plant biotechnology and genetic engineering division, radiation entomology and acraology division, microbiology and industrial irradiation division, agrochemical and environmental research unit-IFRB, Isotope hydrology division, reactor and neutron physics division, nuclear and radiation chemistry division-INST, health physics and radiation waste management unit, tandem accelerator facilities-INST at AERE.
- Repair and maintenance of HT & LT power supply in all institute and residential colony at AERE.
- Checked of monthly electricity bill at AERE office and residential area.
- Repair and maintenance of 22 nos. three phase and single-phase circuit breaker for laboratory instrument and air condition power supply system of all institute at AERE.
- Replacement of 15 KVA Pole mounted transformer use only of DG Banglo of residential colony at AERE.
- Repaired 20 nos. ceiling fan of INST, IFRB, CAD, ICS, TI, police camp at AERE campus.
- Repaired 260 nos. ceiling fan of quarter no.C-1/5, E-2, E-3, F-1, F-3, officer hostel staff hostel, tin shed house at AERE.
- Installation of 30 nos. new ceiling Fan in all institute and AERE residential colony at AERE.
- Installation of 6 nos. new exhaust fan in all institute and residential colony at AERE.

1.3 Civil Engineering Division

Major activities of the civil engineering division are given below: -

- Repair & maintenance works of (RCC slab) palisading guide wall surrounding of CAD building at AERE
- Repair & maintenance works of Institute of energy science building at AERE.
- Damaged roof & false ceiling repair of the food safety and quality analysis division lab (S#106) of IFRB at AERE
- Repair & maintenance works of dosimetry laboratory of gamma source division of IFRB at AERE
- Making and supplying, fitting & fixing of fiber glass sheet for roof shed cover of semi case field of IFRB at AERE
- Repair & maintenance works of quarter no. C-2/5, D-1/4, D-1/6, E-3/18, and officer's dormitory of room no-310,410 & 412 at AERE housing colony.
- Repair, maintenance & modification work of common toilet (ladies zone) of INST at AERE,
- Repair, maintenance works of common toilet with others of INM at AERE,
- Separation works of washrooms for male and female officers of INM at AERE.
- Renovation repair & maintenance works of iBAS ++ room of CFAD at AERE.
- Estimate for renovation works of playground at AERE campus.
- Repaired & maintenance works of quarter no. C-1/15, C-2/3 D-1/3, D-1/6, D-2/6, E-1/6, E-1/9, E-1/15, E-2/2, E-2/8, E-2/9, E-2/10, E-2/12, E-2/20, E-3/16, E-3/4, E-4/5, E-4/10, E-4/16, F-1/13, F-2/9, F-2/1, F-3/5, F-3/6, officers' hostel/dormitory no. 216, 312, F-2 building back side plaster, E-2 building stair repairing, road repairing in the front side of E-1 building of residential area at AERE.

1.4 Central Engineering Workshop Division

Major activities of the central engineering workshop division are given below: -

- Made of wooden box for sending ground water samples for tritium analysis from Khulna, Bagerhat and Satkhira to PINSTECH, Pakistan from isotope hydrology division of INST at AETE under RCA-RAS 7040 program conducted by IAEA
- Management unit (HPRWMU), INST and replacement of steel almira glass shelves used for storage of replacement of window glass in the main building of health physic and radioactive waste research work samples
- Repair of fume hood used for research work of health physic and radioactive waste management unit (HPRWMU) of INST at AERE.
- Changed the bathroom door (cosmic door) of director IE at AERE.
- Repaired & maintenance works of doors of SIU at AERE.
- Repaired of two doors of room no 402 of officer's dormitory at AERE colony.
- Installed wooden main door with necessary fitting of office side, different building and residential colony at AERE.
- Performed machining, welding, sheet-metal works, carpentry works etc. as per requisition of different institute and residential building at AERE.
- Repaired & maintenance works of training institute auditorium at AERE.
- Changed the door with frame of room no.143 of RNP division of INST at AERE.
- Repaired & maintenance works of VIP guest house door at AERE.
- Installed door locks of different institute office room's door and different room of officer's dormitory at AERE.
- Repaired book shelf of RNP division of INST at AERE.
- Repaired of central cafeteria steel table at AERE.
- Made a notice board for AERE central mosque at AERE Colony.
- Repaired & maintenance works of window glass, door lock, hazbolt, door frame and shutter for different institute and officer's dormitory at AERE.
- Repaired of display board of gamma source division of IFRB at AERE.

1.5 Air conditioning Division

Major activities of the air conditioning division are given below: -

- Installation of 05 nos. new split type air cooler (2 ton) of RNP, NNA Lab INST and training institute at AERE.
- General servicing around 102 nos. of window & split type A/C of all institutes at AERE.
- Repaired 36 nos. of window & split type AC of INST, IFRB, TI, IE, ICS, VIP guest house, TAD, INMP, cafeteria, INM & CAD building at AERE.
- Replaced around 10 nos. of blowers of window & split type AC, 08 nos. of compressor of AC & refrigerator and repaired around 10 nos. of refrigerator & fridge in different institutes at AERE.
- Other refrigeration systems such as cooling incubators, dehumidifiers etc. have been repaired of the laboratories of various institutes at AERE.
- As per routine work the central air- condition plant of INST auditorium is operated once time on every week.
- Fitting fixing of capacitor and gas charge of window & split type A/C of different institutes at AERE.
- Replace around 10 nos. blower's motor of window & split type A/C of different institutes at AERE.
- Replace around 6 nos. electronic circuit of window & split type A/C of different institutes at AERE.
- Overhauling, repairing, servicing, testing and commissioning of machine no. 2 of central air conditioning plant of INST auditorium at AERE.
- A total of 16 nos. window and split-type air cooler and refrigerator have been charged of R-22, R-410A, R-12 gas of all institute at AERE.
- There are 7 nos. refrigerator have been repaired & maintained of various institutes at AERE.
- Replaced around 17 nos. magnetic contactors of window & split type Air cooler of different institutes at AERE.

- Replaced around 15 nos. overload and relay of window & split type Air cooler of different institutes at AERE.
- Repaired chiller/central Air conditioning plant in lianke lab of INMP at AERE.
- Removed duct of the central air condition plant f IFRB AERE.
- Replace around 4 nos. compressor of window & split type A/C of different institute at AERE.
- Repaired chiller/central air conditioning plant in AER lab of IFRB at AERE.

1.6 International Conferences

Nadim Mahmood Nayeem, MdFoisal Hossain, Muhammed Sohel Rana, MdShafiul Ferdous, “Influence of ageing in different mediums on the mechanical properties of JUCO/Carbon epoxy composites”, ICCESD2024 (7th International Conference on Civil Engineering for Sustainable Development, 2024), 7-9 February, 2024, KUET, Khulna, Bangladesh.

IV. INTERNATIONAL AFFAIRS DIVISION (IAD), BAEC HQ

International Affairs Division (IAD), Bangladesh Atomic Energy Commission (BAEC), has been maintaining assigned liaisons regularly with the international organizations and foreign countries since its inception. The liaison are bordered normally to the nuclear technology transfer, modernization of nuclear instrumentation, establishing nuclear power plants and development of human resources for the peaceful applications of nuclear science and technology in the country. Under the supervision of BAEC, IAD directly communicates with international organizations to get international projects and simultaneously monitors the progress of the projects under implementation. In order to strengthen the overall nuclear capability of the country, this division makes liaison for foreign trainings, fellowships and scientific visits for scientists, engineers, doctors, geologists, technicians as well as for administration personnel. In the financial year 2023-2024, IAD has processed nominations of approximately 388 participants for various international programme in different countries. IAD also works to arrange expert missions, international meetings, trainings, workshops, seminars, etc. in BAEC as well as in the country. IAD plays an important role to execute bilateral and multilateral agreements with foreign countries for the enhancement of R&D (Research and Development) activities in the country. Moreover, to fulfill the international obligations related to nuclear safeguards and non-proliferation of nuclear weapons, IAD has also been in constant communication with the International Atomic Energy Agency (IAEA), United Nations Organization (UNO), etc. since the inception of BAEC. A brief description of the activities of IAD during the period of “July, 2023 – June, 2024” is presented below.

1. Activities

1.1 Technology Transfer

BAEC has been receiving technical assistances mainly from IAEA through Technical Cooperation (TC) Projects, Regional Cooperation Agreement (RCA) and Regional Cooperation Non-Agreement (Non-RCA) Projects, Coordinated Research Projects (CRP) and other special projects of IAEA. As the assigned liaison point of IAEA, IAD is liable to monitor the progresses and outputs of these projects, the reports and to submit the reports to the IAEA, to arrange expert visits, scientific visits, trainings and fellowships for the scientists involved with these projects. IAD also helps the project counterparts to organize training courses, seminars, meetings, etc. in the country.

1.2 Technical Cooperation (TC) Projects

In the current TC cycle, there are 06 (six) TC projects are under implementation. IAD is working for the successful implementation for these ongoing TC projects as well as simultaneously giving efforts to obtain new TC projects in different priority areas of development perspective of the country and hence to achieve the targets of SDGs. The TC projects are covering different thematic areas of IAEA including Nuclear Power, Nuclear Agriculture, Human Health, Environment and Water Resources etc.

1.3 Regional Cooperative Agreement (RCA) Projects

RCA is an intergovernmental agreement among IAEA Member States in Asia and the Pacific region. Supported by IAEA, the projects developed and implemented by the countries of this region are commonly

known as RCA projects. Such projects are involved in research & development and training activities in the related fields of nuclear science and technology through sharing of regional resources including facilities, equipment and expertise as well as exchange of knowledge. IAD performed liaison for 18 (eighteen) RCA projects covering different fields namely; Agriculture, Human Health, Industry, Environmental Protection and Water Resources.

1.4 Non-RCA Projects

The Non-RCA Projects are based on Asian Region supported by IAEA Technical Cooperation (TC) programme. In these projects, countries from Middle East are also involved along with the 22 (twenty two) RCA countries. In the reported year, IAD made liaison for 24 (twenty four) Non-RCA projects covering Nuclear Power Planning, Sustainability of Nuclear Institute, Nuclear Capacity Enhancement, Strengthening Radioactive Waste Management and Radioactive Exposure Control, Irradiation, Physical Protection, Strengthening Health Support, etc.

1.5 Coordinated Research Projects (CRPs)

Bangladesh avails IAEA research supports through the Coordinated Research Projects (CRPs) as well. Such research activities are normally run by the research institutes of both the developing and developed countries that are member of IAEA and working on the same research area of interest. For CRPs, IAEA funds a portion of the project's cost. IAD worked as a liaison body for a number of 16 (sixteen) CRP projects covering the research area of Food and Agriculture, Human Health, Physical and Biological Sciences, Nuclear Installation Safety, Nuclear Fuel Cycle, Nuclear Security Culture and Waste Technology. In addition to BAEC, research institutes and Universities of Bangladesh such as ICDDR, Dhaka University, Bangladesh Agricultural University (BAU), Radiation Oncology Department, Hospitals Centre for Woman and Child Health are involved with the CRPs.

1.6 Projects of the Forum for Nuclear Cooperation in Asia (FNCA)

IAD is the focal point to implement the FNCA projects. The framework of this forum specified to various vital nuclear fields such as: utilization of research reactors, utilization of radioisotopes in agriculture, application of radioisotopes and radiation for medical use, public information of nuclear energy and radiation safety and radioactive waste management, safety culture of nuclear energy, human resources development. The present members of this forum are Japan, Mongolia, Kazakhstan, Australia, Bangladesh, China, Indonesia, Republic of Korea, Malaysia, Philippines, Thailand and Viet Nam. In the financial year 2023-2024, IAD made liaison for a number of 07 (seven) FNCA projects.

1.7 Exchange of Experience and Expertise

Under the Exchange Programs of the Ministry of Education, Culture, Sports, Science and Technology (MEXT) and Nuclear Safety Research Association (NSRA) of Japan, nuclear researchers from neighboring Asian countries are invited to Japan and Japanese experts are dispatched to other countries. As the focal point of this program, IAD provides support and processes necessary documents in favor of the selected scientists, engineers, doctors and technicians of BAEC. Both of these exchange programs are helpful to gather state-of-the-art technical knowledge and to perform high-level research work in Japan for contributing to build up and strengthening the nuclear base and nuclear safety culture in BAEC.

1.8 Instructor Training Courses (ITCs) and Advance Instructor Training Courses (AITCs)

Japan also provides support in developing Instructors (trainer) in different fields of nuclear science and technology. Instructor Training Course one under which the scientists from BAEC get opportunity to be trained up as an Instructor in Japan. Upon completion of the training course in Japan they work as an Instructor to train up scientists and contribute to the development of human resources in the respective fields back in Bangladesh. Japan also conducts AITCs for personnel previously trained up as Instructors. During the reporting period, about 05 (five) participants have completed ITCs and AITCs in Japan.

1.9 Database of Foreign Visitors

From July 2008, IAD has been maintaining database for the foreign visits of employees of BAEC. This includes various conferences, meetings, trainings, workshops organized by TC, RCA, Non-RCA, FNCA, Asia

Nuclear Safety Network (ANSN), etc. Officials from BAEC, MoST and other organizations have attended conferences, meetings, workshops and availed significant number of trainings and fellowships in the reported period under TC, RCA, FNCA etc. projects.

V. NUCLEAR POWER AND ENERGY DIVISION (NPED), BAEC HQ

Objective

Nuclear Power and Energy Division (NPED) is one of the most important divisions of the Bangladesh Atomic Energy Commission (BAEC). Since the very beginning of this division, it has been working on research and development for the implementation of the nuclear power program in Bangladesh through developing nuclear infrastructure and human resources. NPED is playing an important role in the assessment of the primary energy mix, and the assessing the possibility of implementing nuclear power projects in Bangladesh.

1. R&D work(s)

1.1 Analyzing Thermal-Hydraulic Parameters During Cold Leg Loss of Coolant Accident Without Reactor Scram Using PCTTRAN model of VVER-1200

Muhammed Mufazzal Hossen, Saikat Ahmed and Mahmud Hossain

The loss of coolant accident in the cold leg, including breaks of 0.000507 m² (Case-1), 0.008110 m² (Case-2), 0.129720 m² (Case-3), 0.164170 m² (Case-4), 0.202680 m² (Case-5), and 0.240800 m² (Case-6), with the concurrent incident of anticipated transient without scram (ATWS) and loss of AC power, have been analyzed applying personal computer transient analyzer of the VVER-1200 pressurized water reactor (PWR). The larger break results in a smaller pressure and temperature of the primary system. The secondary pressure was stabilized earlier for the larger breaks. There was no decrease in the liquid level of the core in Cases 1 and 2, but it collapsed in Cases 3, 4, 5, and 6 just after the accident. The pressurizer liquid level increases rapidly for Cases 1 and 2 due to the liquid surge, but it collapsed in Cases 3, 4, 5, and 6. The break mass flow rate decreases to a plateau value earlier for smaller breaks. The thermal power of the reactor, peak cladding temperature (PCT), and fuel temperature showed a rapid drop after the accident, followed by a peak. At the end of the simulation, there was a drastic drop in reactor thermal power, PCT, and fuel temperatures for Case-6 due to the supply of boric acid solution to the reactor. Among the accident cases, the maximum values of PCT and peak fuel temperature for Case-6 were recorded as 646.20 °C and 2084.88 °C, respectively, which is within the acceptable range for a design basis accident of a PWR.

1.2 Transient Analysis of LBLOCA with Subsequent Loss of Offsite Power and Loss of All AC Power in VVER-1200 Reactor

Md Asaduzzaman, Md Mehedi Hassan, Md Kabir Hossain, Md Shahinoor Alam, Mohammad Omar Faruk, and K M Jalal Uddin Rumi

The generation III+ VVER-1200 (AES-2006) reactor is equipped with improved safety features with component redundancy compared to the previous models. This paper is concerned with the performance of active and passive safety features during the transient of a major beyond design basis accident (BDBA) scenario of the reactor. The study is done considering large break loss of coolant accident (LB LOCA) with loss of offsite power (LOOP) and LB LOCA with loss of all AC power (LOACP) sources namely station blackout (SBO) using VVER-1200 NPP simulator. It was found that the reactor is capable of mitigating such BDBA scenarios by the effectiveness of the active and passive safety systems. Moreover, LB LOCA with LOACP is observed to be more severe compared to LBLOCA with LOOP. This comparative analysis is compatible with IAEA safety guidelines.

2. Manpower Development (Training/Fellowship/Workshop/Meeting)

2.1 Attended in Training/Fellowship/Workshop/Meeting

Sl. No.	Title of the program	Date	Place	Number of participants
1.	Participation of Learning Session for the Improvement of Efficiency	04 September, 2023	BAEC Auditorium, Agargaon, Dhaka	01

	of Employees of BAEC in Related to the Current Affairs.			
2.	Participation of Training on Digital Signature for the officers of BAEC.	19 December, 2023	BAEC Auditorium, Agargaon, Dhaka	02
3.	PPR 2008 and Annual Procurement Planning.	21-25 January, 2024	BIM, Dhaka	03
4.	Consultants' meeting of the ASENES pilot study on sustainable deployment scenarios for small modular reactors.	16-19 April, 2024	Vienna, Austria	01

3. Collaboration Work/MOU (ADP/FNCA/MEXT/FTC/IAEA/RCA/TC/S&T/CRP/In-house project, Universities, etc.)

ADP project on 'Establishment of Offsite Water Intake Facility for Rooppur Nuclear Power Plant'

4. Others

- Prepared DPP of the ADP project titled 'Project on Feasibility Study of 3rd and 4th Unit of Rooppur Nuclear Power Plant and Construction of other Necessary Infrastructures and Residential Facilities of the Power Plant'
- Updated the background information on the status and development of nuclear power programs in Bangladesh for 'Country Nuclear Power Profiles' of IAEA.

VI. CONSTRUCTION OF ROOPPUR NUCLEAR POWER PLANT (RNPP)

Objective

Rooppur Nuclear Power Plant (Rooppur NPP) is the first nuclear power plant of Bangladesh, currently under construction following the guidelines the IAEA and complying the regulatory requirement and terms and conditions of license issued by Bangladesh Atomic Energy Regulatory Authority. The Rooppur NPP contains two units with the capacity of 1.2GW each. The Plant is located on the bank of Padma in Pabna district of Bangladesh. Bangladesh is building Rooppur NPP under Ministry & Science and Technology with financial and technical support from the Russian Federation. With the commissioning of Rooppur NPP Bangladesh will become the third country in South Asia to have nuclear power. Nuclear power plant (NPP) generates low-cost electricity and meet modern society's demand for dependable and affordable electricity. The implementation of Rooppur NPP project with a total capacity of 2,400 MW is extremely important for the development of our country, as our goal is to turn on the lights in every Bangladeshi home, to achieve SDGs and development objectives of the nation. It will help in ensuring energy security and achieving energy independence of the nation.

1. Manpower Development (Training /Fellowship/ Workshop/Meeting): follow the format below

1.1 Attended in Training/Fellowship/Workshop/Meeting

Sl. No.	Title of the program	Date	Place	Number of participants
1.	Workshop on Funding Mechanisms for Radioactive Waste and Spent Fuel Management and Decommissioning"	22-25 January 2024	Atomic Energy Center, Dhaka	25
2.	Training on "Smart Office Alignment with Smart Bangladesh"	28 April 2024 - 09 May 2024	Online	03
3.	Training on "Training on Public Procurement Management (3-weeks)"	22 April-09 May 2024, 25 May 2024 - 10 June 2024	Engineering Staff College	04

4.	Training on Operation & Maintenance of Conventional Power Plant	18-30 November 2023, 24 February – 06 March 2024, 20-30 April 2024, 11-21 May 2024, 01-11 June 2024	Ghorashal and Payra Power Plant	125 (25 Trainees each Batch)
5.	Training on “Reactor Engineering”	3-14 December 2024	AERE, BAEC	05
6.	Training on “Nuclear and Radiological Emergency Preparedness Course”	10 September 2023 - 21 September 2023	AERE, BAEC	03
7.	Training on “Reactor Engineering”	29 October 2023 - 02 November 2023	AERE, BAEC	02
8.	Turbine Shop	28 August 2023 – 12 April 24, 25 September 2023 – 17 May 2024, 31 July 2023-15 March 2024	Russian Federation	7
9.	Nuclear Safety and Reliability	28 August 2023 – 29 March 2024	Russian Federation	8
10.	Inspection and Safety Assurance Department	28 August 2023 – 29 March 2024	Russian Federation	15
11.	APCS and EE Service (I&C Shop)	7 November 2023 – 26 July 2024, 17 June – 02 December 2024	Russian Federation	13
12.	APCS and EE Service (Electrical Shop)	3 July 2023 – 30 October 2023, 7 November-2023 – 21 Jun 2024	Russian Federation	24
13.	Operation and Maintenance of the Technical Equipment set of Physical Protection System	15 July 2024 - 03 August 2024, 05 August 2024 -23 August 2024, 24 June -12 July 2024	Russian Federation	7
14.	Russian Federation- IAEA Nuclear Knowledge Management School	7th August 2023- 11th August 2023	Russian Federation	1
15.	Interregional Training Course on Establishing Arrangements and capabilities for Emergency Preparedness and Response	4th September 2023- 8th September 2023	Russian Federation	1
16.	Training Course on Leadership, Management and Culture for Safety	6th May 2024- 10th May, 2024	Vienna, Austria	1
17.	Technical Meeting on Innovation, Advances and Developments in the Water Chemistry of Pressurized Water Reactors	22nd April 2024 – 26th April 2024	Vienna, Austria	1
18.	International Training Course on Practical Operation of Physical Protection systems at Nuclear Facilities- For Practitioners	28th May 2024 - 5th June 2024	Russian Federation	2
19.	Bangladesh National Training Course on Nuclear Security Recommendations on Physical Protection of Nuclear Materials and Nuclear Facilities	18th September 2023- 22nd September 2023	Russian Federation	16
20.	Technical Meeting On Protection on Nuclear Installations Against External Hazards	19th September 2023- 22nd September 2023	Vienna, Austria	1

2. Organize Training/Fellowship/Workshop/Meeting

Sl. No.	Title of the program	Date	Place	Number of

				participants
1.	Basic course on maintenance and Repair for Rotating equipment group	14 -18 Nov'21	Rooppur NPP Training center	10
2.	Workshop on visual and Measurement	22 Sep - 18 Oct'22	Rooppur NPP Training center	7
3.	Workshop on OSART Methodology	29-31 May'23	Rooppur NPP Training center	30
4.	Introductory Training on Main Electrical Circuit Simulator	17-19 July'23	Rooppur NPP Training center	3
5.	Introductory Training on Main Electrical Circuit Simulator	25-27 July'23	Rooppur NPP Training center	3
6.	Fire Safety Fundamentals at NPP	21-23 Aug'23	Rooppur NPP Training center	114
7.	Workshop on SAT	10-11 Dec'23	Rooppur NPP Training center	10
8.	Work at height	17 - 18 Dec'23	Rooppur NPP Training center	5
9.	Workshop on Main Electric circuit simulator	19 Dec'23	Rooppur NPP Training center	2
10.	Introductory Training on Pick and Place Simulator	19 Dec'23	Rooppur NPP Training center	4
11.	Introductory Training on M&R Documentation	20 Dec'23	Rooppur NPP Training center	4
12.	Fire Safety Fundamentals at NPP	24 Dec'23	Rooppur NPP Training center	5
13.	Workshop on Main Electric circuit simulator	26 Dec'23	Rooppur NPP Training center	2
14.	Introductory Training on Heat Exchange Equipment	26 Dec'23	Rooppur NPP Training center	10
15.	Introductory Training on Thermal Mechanical Equipment and Ventilation Systems	27 Dec'23	Rooppur NPP Training center	10
16.	Introductory Training on Work at height on Dismountable polygon	01 – 02 Jan '24	Rooppur NPP Training center	5
17.	Workshop on Main Electric circuit simulator	01 - 03 Jan'24	Rooppur NPP Training center	2
18.	Introductory Training on Pick and Place Simulator	03 Jan'24	Rooppur NPP Training center	4
19.	Introductory Training on M&R Documentation	04 Jan'24	Rooppur NPP Training center	10
20.	Fire Safety Fundamentals at NPP	09 Jan'24	Rooppur NPP Training center	5
21.	Workshop on Main Electric circuit simulator	09-11 Jan'24	Rooppur NPP Training center	2
22.	Introductory Training on Heat Exchange Equipment	09 Jan'24	Rooppur NPP Training center	10
23.	Introductory Training on Thermal Mechanical Equipment and Ventilation Systems	10 Jan'24	Rooppur NPP Training center	10
24.	Ultrasonic Testing	11 Jan'24	Rooppur NPP Training center	8
25.	Fire Safety Fundamentals at NPP	15 Jan'24	Rooppur NPP Training center	5
26.	Workshop on Main Electric circuit simulator	16-18 Jan'24	Rooppur NPP Training center	2
27.	Ultrasonic Testing	16 Jan'24	Rooppur NPP Training center	8
28.	Workshop on Main Electric circuit simulator	21 Jan'24	Rooppur NPP Training center	2
29.	Introductory Training on machine repair and maintenance	22 Jan'24	Rooppur NPP Training center	8
30.	Ultrasonic Testing	23 Jan'24	Rooppur NPP Training center	8
31.	Introductory Training on M&R Documentation	23 Jan'24	Rooppur NPP Training center	12
32.	Workshop on relay protection and automatics	23 Jan'24	Rooppur NPP Training center	11
33.	Workshop on Main Electric circuit	23 - 24 Jan'24	Rooppur NPP Training center	33

	simulator			
34.	Introductory Training on Pick and Place Simulator	28 Jan'24	Rooppur NPP Training center	2
35.	Nuclear and radiation Safety for Rooppur NPP Medical personnel	29 Jan'24	Rooppur NPP Training center	4
36.	Nuclear and radiation Safety for Rooppur NPP Medical personnel	29 Jan'24	Rooppur NPP Training center	11
37.	Ultrasonic Testing	30 Jan'24	Rooppur NPP Training center	13
38.	Nuclear and Radiation Safety	30 Jan'24	Rooppur NPP Training center	8
39.	Nuclear and Radiation Safety	29 Jan'24	Rooppur NPP Training center	11
40.	Ultrasonic Testing	30 Jan'24	Rooppur NPP Training center	13
41.	Theoretical and Simulator Training on Fire safety	06 Feb'24	Rooppur NPP Training center	8
42.	Theoretical and Simulator Training on Fire safety	28 April'24	Rooppur NPP Training center	7
43.	Theoretical and Simulator Training on Fire safety	29 April'24	Rooppur NPP Training center	7
44.	Theoretical and Simulator Training on Fire safety	30 April'24	Rooppur NPP Training center	7
45.	Theoretical and Simulator Training on Fire safety	05 May'24	Rooppur NPP Training center	7
46.	Theoretical and Simulator Training on Fire safety	06 May'24	Rooppur NPP Training center	7
47.	Theoretical and Simulator Training on Fire safety	7 May'24	Rooppur NPP Training center	7
48.	Theoretical and Simulator Training on Fire safety	8 May'24	Rooppur NPP Training center	7
49.	Theoretical and Simulator Training on Fire safety	12 May'24	Rooppur NPP Training center	7
50.	Theoretical and Simulator Training on Fire safety	13 May'24	Rooppur NPP Training center	7
51.	Theoretical and Simulator Training on Fire safety	14 May'24	Rooppur NPP Training center	7
52.	Theoretical and Simulator Training on Fire safety	15 May'24	Rooppur NPP Training center	7
53.	Theoretical and Simulator Training on Fire safety	21 May'24	Rooppur NPP Training center	7
54.	Theoretical and Simulator Training on Fire safety	20 May'24	Rooppur NPP Training center	7
55.	Theoretical and Practical Training on Work at Height on Dismountable Polygon	28 May'24	Rooppur NPP Training center	7
56.	Theoretical and Practical Training on Work at Height on Dismountable Polygon	19 May'24	Rooppur NPP Training center	7
57.	Theoretical and Practical Training on Work at Height on Dismountable Polygon	20 May'24	Rooppur NPP Training center	7
58.	Theoretical and Practical Training on Work at Height on Dismountable Polygon	21 May'24	Rooppur NPP Training center	7
59.	Theoretical and Simulator Training on Fire safety	28 May'24	Rooppur NPP Training center	7
60.	Theoretical and Simulator Training on Fire safety	26 May'24	Rooppur NPP Training center	7
61.	Theoretical and Simulator Training on Fire safety	03 June'24	Rooppur NPP Training center	8
62.	Theoretical and Practical Training on	05 June'24	Rooppur NPP Training center	8

	Radiation safety			
63.	Theoretical and Simulator Training on Fire safety	09 June'24	Rooppur NPP Training center	7
64.	Theoretical and Simulator Training on Work at Height	25 June'24	Rooppur NPP Training center	20
65.	Theoretical and Simulator Training on Work at Height	26 June'24	Rooppur NPP Training center	20
66.	Theoretical and Simulator Training on Work at Height	27 June'24	Rooppur NPP Training center	20
67.	Theoretical and Simulator Training on Fire safety	24 June'24	Rooppur NPP Training center	10

5. Oral/Poster Presentation in Seminar/Symposium/Conference(National and International)

Name of the Participant	Title of oral/poster presentation	Title of the event	Organizer	Date	Place
R. A. Naeem1, M. M. Rahman1, M. M. Noby1, R. Alam1, M. Moniruzzaman1, M. G. S. Islam1, Engr. M. A. Islam2	A Study of Boron Regulation in VVER 1200 Reactor Using Physics Simulator	International Conference on Physics 2024	Bangladesh Physical Society	9 th May-11 th May 2024	Atomic Energy Center, Dhaka
M. M. Rahman*1, M. Al-Amin1, T. Sultan1, A. Hossain1, M. M. Noby1, R. Naem1, A. Hasan2, M. Moniruzzaman1, M. G. S. Islam1, Engr. M. A. Islam2, M. S. Akbar3	Analysis of PHRS Effectiveness & Negative Reactivity Effect of VVER-1200/523 Reactor During Beyond Design Basis Accident Scenario	International Conference on Physics 2024	Bangladesh Physical Society	9 th May-11 th May 2024	Atomic Energy Center, Dhaka
T. Sultan1*, S.I. Alam1, M. I. Khar1, S. A. Shumi1, T. Islam1, M. Moniruzzaman1, M. G. S. Islam1, Engr. M. A. Islam2, M. S. Akbar3	Moisture Separator Reheater (MSR) Temperature Variability at Different Loads and Its Impact on Power Generation Efficiency In K-1200-6.8/50 Turbine	International Conference on Physics 2024	Bangladesh Physical Society	9 th May-11 th May 2024	Atomic Energy Center, Dhaka
M. S. Sajib1*, M. M. Noby2, M. A. Amin1, M. N. Abrar1, M. S. Reza1, M. M. Rahman3, M. S. Islam4, M. G. S. Islam2, M. A. Islam5	Assessment of Personnel Action Plan Simulator for Nuclear and Radiological Emergency Communication and Decision-Making,	International Conference on Physics 2024	Bangladesh Physical Society	9 th May-11 th May 2024	Atomic Energy Center, Dhaka
S. N. Hossain*1, Engr. M. A. Islam2, M. G. S. Islam1, M. Moniruzzaman1, M. M. Noby1	Optimizing Personnel Response: A Simulation-Based Approach to Handling Accidents Caused by Fire at Nuclear Power Plant	International Conference on Physics 2024	Bangladesh Physical Society	9 th May-11 th May 2024	Atomic Energy Center, Dhaka
Promod Chandra Baidya1*, Md. Raihanul Haque1, Rumman Mustakim3, Md. Mizanur Rahman2, Md. Golam Sahinoor Islam3, Engr. Md. Ashraful Islam4	Investigation of Emergency Protection Efficiency Without the Most Effective Absorbing Rod for First Fuel Loading Of VVER-1200 of Rooppur NPP by KASKAD And RPMAS	International Conference on Physics 2024	Bangladesh Physical Society	9 th May-11 th May 2024	Atomic Energy Center, Dhaka
M. M. Noby1*, M. M.	Assessment of the "CAS	International	Bangladesh	9 th May-	Atomic

Rahman1, M. A. Amin1, M. S. Sajib2, R. Mustakim1, R. Alam1S.N. Hossain1, A. Hassan1, M. Moniruzzaman1, M. G. S. Islam1, Engr. M. A. Islam3	Simulator" For the Implementation of a Personnel Action Plan in The Event of a Radiological Emergency at Ropppur NPP	Conference on Physics 2024	Physical Society	11 th May 2024	Energy Center, Dhaka

VII. NUCLEAR SAFETY, SECURITY AND SAFEGUARDS DIVISION (NSSSD), BAEC HQ

Objective

- To fulfill the obligations under International Treaties, Agreements, Protocols and Conventions related to Nuclear Safety and Radiological Emergencies including Safeguards and Physical Protection of nuclear and radioactive material shaving in the BAEC.
- To maintain safeguards procedures including the State Systems of Accounting for and Control of Nuclear Material (SSAC). and Nuclear Material Accountancy & Control (NMAC)
- To ensure the physical protection of nuclear material and radioactive sources and associated installations of BAEC.

On behalf of BAEC, this Division has been acting as the focal point of different well-known strategic partner namely International Atomic Energy Agency (IAEA), U.S. Department of Energy (U.S. DOE), Japan Atomic Energy Agency (JAEA), Forum for Nuclear Cooperation in Asia (FNCA) and Asia-Pacific Safeguards Network (APSN) for the issues of nuclear safeguards, safety, security and physical protection of radioactive materials and associated facilities.

Programme(s)

1. R&D work(s)

NSSSD works as a scientific administration of the Commission in the areas of nuclear safety, security and safeguards. The primary function of the Division is to assist the Commission to undertake policy prepare policy documents, maintain communication with national and international parties and conduct collaborative activities (national/international) with a view to ensuring and continuous improvements of nuclear safety, security and safeguards in the nuclear/radiation facilities owned and operated by the BAEC.

VIII. PLANNING AND DEVELOPMENT DIVISION (PDD), BAEC HQ

Planning and Development Division of Bangladesh Atomic Energy Commission is entrusted with the responsibility of devising and processing development project plans for institutional advancement. Since its formation, the division has been the harbinger for achieving the far-reaching goals of achieving excellence in the nuclear science and technology sector of the country through the assessment, review, refinement, processing and submission of research and development project proposals of BAEC. In tandem with the Perspective Plan 2021-2041 adopted to build a developed and prosperous Shonar Bangla in 2041, the Eighth Five-year Plan, as well as government's commitment to achieve Sustainable Development Goals (SDGs), PDD's paramount objective is to provide assistance in preparation, implementation and monitoring of development projects. In addition to that, PDD plays pivotal role in facilitating development of skilled human resources in the science and technology sector. Apart from that, qualitative change in commission's activities is also intertwined in PDD's dominant objective. PDD frequently organizes trainings, workshops and seminars on E-Governance and 4th IR to accelerate people's access to services offered by BAEC and to promote scientists in innovation.

Programme(s)

Planning and Development Division undertakes programs which comprises assessment, review, refinement, and processing of development projects aimed at Annual Development Program (ADP) and special allocation projects. In addition to that, PDD conducts administrative measures to forward Research and Development projects (R&D) and Science & Technology (S&T) projects to the line ministry. PDD also plays the role of

superintendence and monitoring of R&D and S&T projects as per line ministry's directive. Incoherence with the programs PDD frequently arranges different ADP project implementation committee meetings and assists organizing steering committee meeting.

The total RADP allocation of the year 2023-2024 for implementation of ongoing projects of BAEC was Tk. 1005768.00 Lakh. Out of this granted allocation, Tk. 949910.81 Lakh had been spent up to 30 June 2024 making an implementation rate of 94.45%. The entire picture on the advancement of all the development projects currently under implementation is depicted in the following table.

1. Advancement of the Development Project of BAEC under RADP

(Taka in lakh)

Sl. No	Name of the project, project implementation period	Estimated cost total (Foreign Currency)	Cumulative expenditure up to, June 2023 (Foreign Currency)	Revised allocation for the year 2023-2024 (Foreign Currency)	Expenditure during 1 st Jul. 2023 to 30th June 2024 (Foreign Currency)	% of expenditure against allocation up to 30th June 2024 (% of Expenditure against released fund)	Achievement of the projects
1	2	3	4	5	7	9	10
On-Going Projects:							
01.	Construction of Rooppur Nuclear Power Plant (Apr. 2016 - Dec. 2025)	11309291.27 (1016000.00)	6583027.51 (5125299.39)	970676.00 (9000.00)	915095.56 (9000.00)	94.27% (100%)	Ongoing
02.	Establishment of Cyclotron & PET-CT at Institute of Nuclear Medicine & Allied Sciences (INMAS) Mymensingh & Chattogram and Cyclotron facilities at Institute of Nuclear Medical Physics (INMP), Savar, (July, 2018 - Jun. 2025)	70300.00 (33923.00)	26151.25 (8300.83)	12820.00 (10412.00)	12820.00 (10412.00)	100% (100%)	Ongoing
03.	Balancing, Modernization, Refurbishment and Extension (BMRE) of Safety Systems of the 3 MW	8543.58 (4180.14)	7402.43 (3991.30)	810.00 (188.00)	746.89 (188.00)	92.21% (97.47%)	Ongoing

Sl. No	Name of the project, project implementation period	Estimated cost total (Foreign Currency)	Cumulative expenditure up to, June 2023 (Foreign Currency)	Revised allocation for the year 2023-2024 (Foreign Currency)	Expenditure during 1 st Jul. 2023 to 30th June 2024 (Foreign Currency)	% of expenditure against allocation up to 30th June 2024 (% of Expenditure against released fund)	Achievement of the projects
1	2	3	4	5	7	9	10
	TRIGA Mark-II Research Reactor Facility at AERE, Savar, Dhaka, (July 2018 - June 2024)						
04.	Strengthening of existing gamma source of Bangladesh Atomic Energy Commission. (January 2021-Jun 2024)	5232.00 (4391.00)	1875.05 (1708.10)	2990.00 (2661.00)	2958.00 (2661.00)	98.93% (98.93%)	Ongoing
05.	Modernization and Strengthening of Services and Research Facilities of the Institute of Tissue Banking and Biomaterial Research (July 2021 – June 2025)	17380.14 (1995.00)	2660.99 (0.00)	2619.00 (0.00)	2616.86 (0.00)	99.92% (99.98%)	Ongoing
06.	Modernization of Laboratories and Enhancement of Service Capacity of 3 Divisions (Chemistry Division, Health Physics Division, Experimental Physics Division) of Atomic Energy Centre, Dhaka.	4498.00 (3112.00)	1305.88 (918.29)	1751.00 (1300.00)	1725.00 (1300.00)	98.52% (98.52%)	Ongoing

Sl. No	Name of the project, project implementation period	Estimated cost total (Foreign Currency)	Cumulative expenditure up to, June 2023 (Foreign Currency)	Revised allocation for the year 2023-2024 (Foreign Currency)	Expenditure during 1 st Jul. 2023 to 30th June 2024 (Foreign Currency)	% of expenditure against allocation up to 30th June 2024 (% of Expenditure against released fund)	Achievement of the projects
1	2	3	4	5	7	9	10
	(July 2021 – June 2024)						
07.	Enhance Capacity of Institute of Nuclear Medicine and allied Sciences (INMAS) INMAS Mitford, Cumilla, Faridpur, Barishal and Bogura. (July 2022- Jun 2025)	23076.00 (13695.00)	855.15 (630.00)	13200.00 (10200.00)	13095.40 (10200.00)	99.21% (99.21%)	Ongoing
08.	Establishment of Institute of Nanotechnology (January 2023 - December 2026)	38078.24 (18737.00)	0.00 (0.00)	186.00 (0.00)	155.13 (0.00)	83.40% (83.40%)	Ongoing
09.	Establishment of Genome Sequencing Facilities at NINMAS, Dhaka and INMAS, Chittagong. (January 2023 - December 2025)	4711.00 3660.00	0.00 0.00	157.00 0.00	149.00 0.00	94.90% (94.90%)	Ongoing
10.	Establishment of offsite water Intake Facility for Roouppur Nuclear Power Plant. (July 2023- June-2025)	24177.00 0.00	0.00 0.00	559.00 0.00	549.00 0.00	98.21% (98.21%)	Ongoing

Sl. No	Name of the project, project implementation period	Estimated cost total (Foreign Currency)	Cumulative expenditure up to, June 2023 (Foreign Currency)	Revised allocation for the year 2023-2024 (Foreign Currency)	Expenditure during 1 st Jul. 2023 to 30th June 2024 (Foreign Currency)	% of expenditure against allocation up to 30th June 2024 (% of Expenditure against released fund)	Achievement of the projects
1	2	3	4	5	7	9	10
	Total	11505287.23 1099693.14	6623278.26 5140847.91	1005768.00 33761.00	989910.81 33761.00	94.45%	

2. New selected GOB Funded (Unapproved) Annual Development projects (ADPs) of BAEC for the Fiscal Year o 2024-25:

Sl No.	Project's Name and Period	Status of Approval	Estimated cost (in Lac taka)	Status of Budget allocation	Opinion
1	Establishment of Institute of Nuclear Medicine and Allied Sciences (INMAS) at 5 Medical College Hospital Campuses in the Country. Project Period: January 2023 - June 2028	In process of approval	69702.00 23295.00	0.00	Selected as GOB Funded ADP project for the FY 2024-25 and in the process of final project evaluation in Planning Commission.
2	Establishment of National Nuclear and Radiological Management Centre. Project Period: July 2024 - June 2027	In process of approval	36245.07 17533.61	0.00	Selected as GOB Funded ADP project for the FY 2024-25 and in the process of approval.
3	Establishment of Cyclotron & PET-CT Facilities in INMAS Khulna, Rajshahi, and Rangpur and Strengthening the Cyclotron & Molecular Imaging Facilities of National Institute of Nuclear Medicine and Allied Sciences (NINMAS). Project Period: July 2024-Jun 2028	In process of approval	77801.90 47817.00	0.00	Selected as GOB Funded ADP project for the FY 2024-25 and in the process of approval.
4	Feasibility study for setting up the 3rd & 4th unit of Rooppur Nuclear Power Plant and Establishment of supporting infrastructure & residential Facilities of Power Plant. Project Period: July 2024-June 2027	In process of approval	270210.47 160.19.00	0.00	Selected as GOB Funded ADP project for the FY 2024-25 and in the process of approval.
5	Execution of initial phase activities for the construction of High-Power Multipurpose Research Reactor (HPMRR). Project Period: July 2024-June 2027	In process of approval	2265.90 220.00	0.00	Selected as GOB Funded ADP project for the FY 2024-25 and in the process of approval.

3. Attended in Seminar/Symposium/Conference/Workshop/Meeting

Sl. No.	Name of the Participant	Title of the Event	Organiser	Date	Place
1	Dr. Syed Mohammad Hossain	The 13th Meeting of The Working Group on RCA Mid-Term Strategy Coordination	IAEA	14-18 August 2023	Vienna, Austria
2	Dr. Mohammad Anwar-Ul-Azim	Training of Automatic Radiomunoassay (RIA) Counter with liquid handling system.	Perkin Elmer, India	27 th May -02 June 2024	New Delhi, India
3	Dr. Mohammad Anwar-Ul-Azim	27 th National Conference of Society of Nuclear Medicine Bangladesh (SNMB)	Society of Nuclear Medicine Bangladesh (SNMB)	08 March 2024	Hotel Intercontinental, Dhaka.
4	Dr. Mohammad Anwar-Ul-Azim & Engr. Anik Das	Training on “Project Processing Appraisal and Managemet System (PPS) Software”	Planning Commission, Ministry of Planning.	05 May 2024	Planning Commission, Ministry of Planning, Dhaka.
5	Dr. Mohammad Anwar-Ul-Azim	Wokshop on Sector Action Plan: Science and Information Technology Sector, Socio Economic Infrastructure Division, Bangladesh Planning Commission, Ministry of Planning.	Socio-Economic Division, Planning Commission, Ministry of Planning.	23 June 2024	Bangabandhu Sheikh Mujibor Rahman Novotheater, Dhaka.
6	Dr. Mohammad Anwar-Ul-Azim	Training on “Grievance redressal Mechanism and GRS Software” and “Right to Information Act”.	Bangladesh Atomic Energy Commission (BAEC)	05 May 2024	Alpha Hall, BAEC, Dhaka.
7	Eng. Anik Das	Technical Meeting on sharing International needs, views and priorities. Concerning the nuclear Security of small Modular reactors.	IAEA	17-21 July 2023	Vienna, Austria
8	Md. Sheik Shadi Khan	Integrated Budget and Accounting System++(iBAS++)	Ministry of Science and Technology	10/02/2024	BRICM Auditorium, Dhaka

4. Stakeholder Meeting

PDD is responsible for regularly coordinating BAEC projects' PIC meetings. Stakeholders of PDD include project directors and PIC members. The following is a summary of the PIC meetings-related material belonging to fiscal year 2023-24.

Date	place	Number of projects discussed
04-09-2023	Alpha Conference Hall	7
02-11-2023	Alpha Conference Hall	1
03-12-2023	Alpha Conference Hall	8
10-03-2024	Alpha Conference Hall	9
06-05-2024	Alpha Conference Hall	7
02-06-2024	Alpha Conference Hall	10

5. Collaboration Work

Type of Collaboration	Collaborating Agency/ Institute	Date
MoU	Gono Bishwabidyalay	13.12.2023

6. IAEA Regional Cooperative Agreement (RCA)

- i) [IAEA/RCA RAS 6105] Improving Cancer Management through Theranostics by Using Radioisotope Based Diagnostic and Therapeutic Techniques (2024-2027).
- ii) [IAEA/RCA RAS 6097] Enhancing Capacity and Capability for the Production of Cyclotron-Based Radiopharmaceuticals.

7. Special Allocation Project of Ministry of Science & Technology:

MoST R & D Grant Project ID: SRG235582, 2023-2024, “In-house development of a semi-automated dispensing system for [¹⁸F]FDG at the Cyclotron facility of National Institute of Nuclear Medicine and Allied Sciences (NINMAS) and optimizing its sterile and aseptic dispensing condition”

8. Other Activities

Dr. Shamshad B. Quraishi, Director, P&D was actively engaged in the following activities [1-21]

- a) Convener of the Perspective Plan Preparation Committee for drafting perspective plan of Head Quarter.
- b) Focal point of BAEC Laboratory Accreditation
- c) Convener of the “Sustainable Development Goal (SDG)” Committee
- d) Convener of the Memorandum of Understanding (MoU) Standing Committee to examine the Draft MoU before signing with various organizations in home and abroad.
- e) Convener of the committee to procuring stationery and printing items for various departments/branches of the head office of the commission and to verify/select the proposals and receive the goods as per the work order.
- f) Team Leader of Annual Performance Agreement (APA) of BAEC
- g) Member of BAEC’s “E-Governance and Innovation” team.
- h) Member of CPF committee for the “Environment, Soil and water Resources” area.
- i) Convener of the “Poromanu Porikroma” Committee to publish the issue regularly
- j) Convenor of the Technical Evaluation Committee for the current ADP project “Establishment of Cyclotron & PET-CT at Institute of Nuclear Medicine & Allied Sciences (INMAS) Mymensingh & Chittagong and Cyclotron facilities at Institute of Nuclear Medical Physics (INMP), Savar”.
- k) Convenor of the Technical Evaluation Committee for the current ADP project “Strengthening of existing gamma source of Bangladesh Atomic Energy Commission”.
- l) Convenor of the Technical Evaluation Committee for the current ADP project “Establishment of Institute of Nanotechnology
- m) Convenor of the Technical Evaluation Committee for the current ADP project “Establishment of Genome Sequencing Facilities at NINMAS, Dhaka and INMAS, Chittagong”.
- n) Convenor of the Technical Evaluation Committee for the current ADP project “Establishment of offsite water Intake Facility for Rooppur Nuclear Power Plant”.
- o) Member of the Editorial Board of the BAEC’s Journal of Nuclear Science and Applications.
- p) Member of Commission's Promotion Bio-Data Evaluation Committee-II.
- q) Member of the reconstituted Standing Committee on Works/Construction/Procurement under the Revenue budget and Projects of the Commission.

- r) Member of Negotiation Team for Contract between Bangladesh Atomic Energy Commission and The Russian Federation for Technical Support and Maintenance of Rooppur NPP (Service Contract).
- s) Member of a Committee for finalization of extension of Level -I schedule as per decision of Joint Coordination Committee (JCC) of Rooppur NPP
- t) Member of Annual Confidential Report (ACR) refinement committee for 9th grade and above as per MoPA.
- u) Member of the committee constituted for the preparation of the DPP of the proposed project on Establishment of National Nuclear and Radiological Emergency Preparedness Centre.
- v) Dr. Mohammad Anwar-Ul-Azim, Principal Scientific officer, Planning & Development Division as actively engaged in the following activities [22-25]
- w) Member, Technical Committee of Proprietary Item Confirmation (BAEC Office order 133/2024, Date: 24 June 2024).
- x) Member, the committee for the quantity and type determination of the kit and medical/scientific equipment for the center/institution, after verifying the demand received from the NINMAS and INMASes of BAEC within the limit of the budget allocation of each financial year (BAEC Office order 140/2024, Date: 30 June 2024).
- y) Member, Technical Evaluation Committee (TEC) of Bangladesh Oceanographic Research Institute (BORI) [2nd Phase].
- z) Member, “Monitoring Team”, “Acceptance Committee” and “Execution Committee” of the ongoing AD Projects of BAEC.

IX. QUALITY MANAGEMENT DIVISION (QMD), BAEC HQ

Like other previous years Quality Management Division (QMD) continued to keep its participation in the implementation activities of RNPP Construction Project in the fiscal year of 2023-2024. QMD was also actively involved in the process of drafting BAEC Organogram. QMD scientists also performed some other activities like “preparation of report on SDGs”; “preparation of Country Programme Framework (CPF)”; “preparation of Perspective Plan for QMD”; “Finalization of Technical Configuration for High Power Multipurpose Research Reactor”; “assistance in the activities of E-Governance & Innovation Team”, and “execution of duties as other different Committee Members”.

Activities

1. RNPP Construction Project Related Activities: QMD Scientists performed the following RNPP Construction Project related activities.

- Performed duties as Incoming Control Inspection Team Member/Leader at Rooppur Nuclear Power Plant (RNPP) Construction Site for Long Term Manufacturing Equipment (LTME) and Non-LTME [(Supply Equipment (SU))].
- Performed activities as Member of the Joint Training Advisory Commission (JTAC) for conducting Training Program of Rooppur NPP Operating Personnel under Appendix 14 of General Contract.
- Performed evaluation activities as Technical Committee Member for the Evaluation of Construction and Erection Works of Rooppur NPP implementation project.
- Performed duties as Joint Coordination Committee (JCC) Member.
- Provided technical support to the Regulatory Inspection Committee about the readiness of the Rooppur NPP Fresh Fuel Storage Facility (00 UFC) to assess the possibility of temporary handover for operation prior to import fresh nuclear fuel to the site.
- Actively involved in reviewing RNPP Construction, Commissioning, Operation and Licensing related documents.
- Participated in reviewing D Class License documents related to Nuclear Fresh Fuel Import for Unit-1 of Rooppur NPP to the site.

- Participated as a Technical Committee member during Readiness Inspection and Temporary Handover of Rooppur NPP Training Center.
- Participated in reviewing and updating the Job Description and Shop Regulations of RooppurNpp.
- Participated in several Milestone Achievement associated meetings of RNPP.
- Participated in several Equipment Specification related meetings.

2. Updating BAEC Organization Structure (Organogram): QMD was actively engaged in preparing draft of BAEC Organization Structure (Organogram).

- **Finalization of Technical Configuration for High Power Multipurpose Research Reactor**
Actively involved in finalization of Technical Configuration for High Power Multipurpose Research Reactor.
- **Developing Country Program Framework (CPF)**
QMD was actively involved in developing the part under the thematic area “Sustainable Power and Nuclear Energy” under Country Program Framework (CPF) required by IAEA. Also participated in preparing the CPF as a whole.
- **Preparing and Submitting several reports on SDGs**
QMD Scientist prepared and submitted BAEC’s Sustainable Development Goals (SDGs) related report (both in Bangla and English) that included:
 - Progress from July 2023 to January 2024.
 - Objectives of the Projects
- **Developing Perspective Plan for QMD and Performing duties as “Head Office Perspective Plan Committee” Member**
Drafted the Perspective Plan for QMD. Also performed duties as “Head Office Perspective Plan Committee” Member.
- **Helping in carrying out tasks and preparing working documents and reports under activities of E-Governance & Innovation Team**
Actively engaged in carrying out tasks and preparing working documents and reports under activities of E-Governance & Innovation Team.
- **Annual Performance Agreement (APA) Related Activities**
Performed duties as Member of Annual Performance Agreement (APA) Team.
- **Performing duties as other different Committee Member**
Performed duties as Member of the Editorial Board of the BAEC Journal of Nuclear Science & Applications.

3. Attended in Seminar/Symposium/Conference/Workshop/Meeting

Name of the Participant	Title of the event	Organizer	Date	Place
Dr. Md. Quamrul Huda, CSO & Director, QMD	Approach to estimate the cost of electricity considering the long-term Management of Radioactive waste	BAEC	24-27 July, 2023	Dhaka, Bangladesh
	training program regarding Digital Signature	ICT Department	19-20 December, 2023	Dhaka, Bangladesh

5. Others Activities

QMD personnel delivered duties as members of some other committees

X. SCIENTIFIC INFORMATION DIVISION (SID), BAEC HQ

Scientific Information Division (SID) of BAEC plays a crucial role in collecting, processing, and disseminating vital information for BAEC's research and development activities. It serves as a key intermediary, facilitating communication between BAEC, government entities, the public, and media. Major

activities include building relationships with various stakeholders, maintaining a library, and providing documentation services.

The purpose of SID is to implement a Smart Integrated Information Management System to effectively share information and knowledge with relevant stakeholders, including policymakers, researchers, media, and the public.

1. Key Functions:

- Documentation, archiving and disseminating information related to scientific research and development across all branches of science
- Managing the organization's communication with the public, media, and other stakeholders, promoting transparency and building trust
- The publication of NSA Journals, Annual Reports, Brochures, Newsletters, and organizational document (BAEC Diary, telephone directory, Seba profile book)
- Preparation and coordination of annual performance agreement (APA) between BAEC and MOST and Different Inst./Centre/ Unit with BAEC
- Newspaper clipping and publicity by press release on training, workshop conducted by BAEC and other BAEC activities, events and services
- Drafting reports and furnishing information to the National Assembly, Ministry of Science and Technology, and other pertinent governmental bodies concerning BAEC's endeavors
- Managing the nomination process for BAEC scientists to participate in a range of national seminars, symposia, conferences, workshops, and similar events
- Issuing tender notices, notifications, and press releases of BAEC in daily newspapers
- Printing BAEC Annual Calendar
- Management of BAEC facebook with uploading BAEC's news and activities
- Photographic service (processed, printed and supplied)

2. Remarkable Achievement 2023-24

Description of work	Quantity	Remarks
Published BAEC Annual Report 2022-2023	300	Published, distributed and uploaded to the BAEC website www.baec.gov.bd
Publishing BAEC Diary 2024	1500	Published and distributed
Publishing BAEC telephone directory 2024 in Bangla	900	Published and distributed
Printing BAEC Annual Calendar 2024	2800	Successfully completed
Publishing job circular, tender notice, advertisement etc. to the daily newspaper.	90	Published in the 110 daily newspapers
Clipping of BAEC related news published in national daily newspaper.	183	Successfully completed
Publish Press release of BAEC programs in daily newspaper.	7	Published in the daily newspapers
Participated different fair such as: “অমরএকুশেবইমেলা, ২০২৪”, “বিজ্ঞান ও শিল্পপ্রযুক্তিমেলা ২০২৪, দেশীয়গবেষণা ও গবেষণায়ক্যারিয়ার উৎসব-২০২৪”.	3	Successfully participated
Photographic service (processed, printed and supplied)	6000	Distributed to the relevant divisions, organizations, etc.
Processed nominations of BAEC scientists to attend various scientific/technical/workshop/ seminar etc. arranged locally by different academic/professional institutes	17	Nomination letters were distributed to the relevant participants
Provide National Parliamentary questions and answers	2	Successfully completed

Description of work	Quantity	Remarks
Provide Parliamentary Committee Report	6	Successfully completed
Providing input for different bilateral contract/MoU/ international conference/meeting	4	Successfully completed
Prepared and provided opinions on the draft policies, acts, laws, issues, etc. of Bangladesh government	5	Successfully completed
Provided BAEC information for Preparation of Ministry Annual Report 2022-2023 for both table and general format	2	Successfully completed
Preparation of annual performance agreement (APA) 2024-2025 between BAEC and MOST	1	Successfully completed
Arranged annual performance agreement (APA) 2024-2025 signing ceremony between BAEC and 39 subordinate organizations	1	Successfully completed
Prepared and provided monthly progress report of BAEC activities to MOST	12	Successfully completed
Prepared and provided 'election manifesto 2018' monthly report to MOST	7	Successfully completed
Prepared BAEC election manifesto action plan for 2024-2028	1	Successfully completed
Prepared and provided APA monthly and quarterly reports of BAEC to MoST	16	Successfully completed
Manages APAMS software of Cabinet Division and submitted quarterly reports with documents to APAMS System	4	Successfully completed
Prepared National Integrity Strategy (NIS) 2024-2025 action plan of BAEC	1	Successfully completed
Prepared and provided National Integrity Strategy (NIS) 2023-2024 quarterly report to the MoST	4	Successfully completed
Manages NIS software of Cabinet Division and submitted quarterly reports with documents to NIS System	4	Successfully completed
Uploaded different programs of BAEC in BAEC social media (facebook) page	15	https://www.facebook.com/baec.dhaka
Arranged learning session, training Programs, etc	3	Successfully completed

XI. HUMAN RESOURCES DIVISION (HRD), BAEC HQ

Objective

The HR division aims to maximize the potential of BAEC's human capital to enhance the organizational performance to achieve its goals to the peaceful uses of atomic energy as well as contributing to the development of a research, innovation and knowledge-based society. The ultimate goal is to plan, develop and manage the human resources of BAEC effectively using approved procedures and tools.

Activities

- To perform routine activities within the present scope of HR division
- To formulate/update the organizational structure and scope of human resources division
- To take initiatives to formulate/update HR policy/procedures, Training Policy/procedures under the guidance of the Commission.
- To monitor and facilitate the higher education and training programme and activities
- To take initiatives for competency development of the employees of BAEC

- To facilitate scientists of BAEC for pursuing higher study both local and abroad especially MS and PhD from reputed universities.
- To develop or contribute in preparation of strategic plan or policy documents – CPF (area: human resource development), Perspective Plan, Ministry Reports etc.
- To take initiatives to formulate/revise/update of Annual Confidential Report (ACR) forms, resume forms, evaluation procedures/evaluation and promotion policies/procedures under the guidance of the Commission.
- To develop relevant project proposal for establishment of national institute for nuclear education and training under the guidance of the commission
- To perform the activities related to Integrated Digital Service Delivery Platform (IDSDP), Smart Bangladesh, e-governance & innovation
- To perform other duties assigned by the commission

1. Manpower Development

The HR division takes necessary steps to nominate suitable candidates for various national training programs. These trainings are mostly organized by Regional Public Administration Training Centre (RPATC), National Academy for Planning and Development (NAPD), Bangladesh Institute of Management (BIM), etc. In this fiscal year, 34 (Thirty-Four) participants from different institutes/divisions of BAEC were nominated for various training. The government is in the process of making all public services online so that they are available at the doorsteps of any citizen. Thus, an Integrated Digital Service Delivery Platform (IDSDP) is developed under the Ministry of Science and Technology (MoST). For the smooth transition from manual services to digital services, the division arranged 10 (Ten) technical and other training programs involving about 150 (One Hundred & Fifty) participants from different institutes of BAEC. The division also organized a day-long Innovation Workshop.

1.1 Attended in Training/Fellowship/Workshop/Meeting etc.

Sl. No	Participant	Title of the program	Organizer	Date	Place
1.	Dr. Md. Shakil Ahmed, Director, HRD	FY2023 Steering Committee Meeting (Nuclear HRD Plan in Bangladesh) between Bangladesh Atomic Energy Commission (BAEC) and Japan Atomic Energy Agency (JAEA)	Bangladesh Atomic Energy Commission (BAEC)	23-24 January, 2024	Dhaka, Bangladesh
2.	Dr. Md. Shakil Ahmed, Director, HRD	স্মার্ট বাংলাদেশ বিনির্মাণে উদ্ভাবনী ধারণা	HRD, BAEC	24 Jun, 2024	Dhaka, Bangladesh
3.	Engr. Md Al Mamun, PE, HRD				
4.	Mr. Shah Alam, SAO, HRD				

2. Organize Training/Fellowship/Workshop/Meeting etc.

Sl. No	Title of the program	Date	Place	Number of participants
□	স্মার্ট বাংলাদেশ বিনির্মাণে উদ্ভাবনী ধারণা	24 Jun, 2024	HRD, BAEC	21
□	Integrated Digital Service Delivery Platform (IDSDP) সংক্রান্ত প্রশিক্ষণ ও পর্যালোচনা কার্যক্রম	Several sessions throughout the year	Different institutes/Divisions of BAEC	150

3. Oral/Poster Presentation in Seminar/Workshop/Symposium/Conference etc.

Participant	Title of oral/poster presentation	Title of the event	Organizer	Date	Place
Dr. Md. Shakil Ahmed, Director,	Innovative Idea to build Smart Bangladesh	স্মার্ট বাংলাদেশ বিনির্মাণে	HRD, BAEC	24 Jun, 2024	Dhaka, Bangladesh

HRD		উদ্ভাবনী ধারণা			
Engr. Md Al Mamun, PE, HRD	Smart HR: Education and Training				

4. Others

- Dr. Md. Shakil Ahmed, Director, HRD worked as a Member of the Editorial Board, Nuclear Science and Applications, the Journal of Bangladesh Atomic Energy Commission.
- Dr. Md. Shakil Ahmed, Director, HRD had been working, up until 20 May 2024, as the Focal Point of BAEC for the development of an Integrated Digital Service Delivery Platform (IDSDP) under the umbrella of Ministry of Science and Technology (MoST). The goal of the digital platform is to transform traditional manual workflows into digital services and bring all public services of MoST and its organizations into one platform. Citizen centric services of BAEC like Testing, Analytical, Calibration, Consultancy and Health Services are meant to be available through this platform.
The Focal Point with the cooperation of the members of the BAEC IDSDP Team took all sorts of initiative related to IDSDP and made liaison with the MoST, the Software Development Company and related institutes of BAEC.
- Director, HRD is assigned as an Innovation Officer from BAEC as well as focal point of Smart Bangladesh.
- Director, HRD is also assigned as a Convenor of BAEC perspective committee as well as a member for various internal committees including Divisional Evaluation Committee and a few external committees.
- Engr. Md Al Mamun, PE, HRD, was the member secretary of the committee to formulate the perspective plan of BAEC headquarters and now working as a member of the committee to formulate the next 20years perspective plan of BAEC.
- Mr. Shah Alam, Sr. Administrative Officer, HRD was appointed as Member Secretary of the IDSDP Team of BAEC. He assisted the Focal Point in organizing all meetings as well as trainings related to IDSDP in BAEC. He also involved in preparing and sending monthly reports related to IDSDP activities of BAEC.
- Sr. Administrative Officer, HRD has also been working as Member Secretary of the Innovation Team of BAEC. He assisted the Innovation Officer in organizing all meetings as well as trainings related to innovation in BAEC.

XII. SCIENTIFIC INFORMATION UNIT, AERE

Objectives

The main responsibilities of the Scientific Information Unit (SIU) are to furnish documentation of the scientific achievements attained in different Institute/Units of the Atomic Energy Research Establishment (AERE) and to collect and preserve scientific documents to be used primarily by the scientists of AERE conducting research and development (R&D) activities in nuclear science and technology. Another important involvement of the Unit is to extend required co-operation and coordination in documenting (both electronic and traditional) seminars/symposiums/workshops etc. held in AERE. In the domain of public relation, the Unit gets involved in attending the official delegates both from home and abroad, and visitors to AERE. The activities/involvements of SIU during the period under report are as follows:

Activities

- Publication of AERE Technical Report: The major documentation activity within the reporting period involves publication of the AERE Technical Report, vol. 28 by the SIU. The report covers the activities and achievements of AERE in 2022. The Unit has published a number of internal reports of different institutes/units of AERE.
- Acquisition of Books and Journals: In the period under report, the Unit collected 04 (Four) books of different titles to be used by the scientists/researchers of AERE.

3. Co-operation in Seminars/Symposium/Workshop held in AERE: The Unit extended technical co-operation (photography) in documenting seminars/symposium/workshops held in AERE.
4. Attendance to Delegates/Visitors: During the period under report the Unit hosted as many as 23 groups of delegates and visitors (comprising 950 visitors) from both home and abroad to AERE.
5. E-journal Service: This Unit has been serving e-journal with the help of HINARI/AGORA/OARE since 2008. Users can download required articles from scientific books and journals from different publishers which are available in the internet.
6. Database Service: The Unit provides on-line database & e-catalogue searching facilities.
7. Fax Service: Fax services are available at the Unit with the modern fax machine for receiving and sending official documents to and from AERE.
8. Current Awareness Service (CAS) and Selective Dissemination of Information (SDI) Service: To inform the scientists and researchers at AERE, where books/journals etc. are listed on the basis of recent collections.
9. News Clipping Compilation and Preservation: News concerning Bangladesh Atomic Energy Commission (BAEC), Rooppur NPP project and nuclear science and technology in general published in daily newspapers are clipped to the Notice Boards of different Institutes/Units of AERE for dissemination and awareness of scientists of AERE.
10. Routine Service: The routine service rendered during the period under report includes (i) photography and documentation service in different national day ceremonies/programmes (ii) photographic service to the officials/employees of AERE for official purpose and reprography service etc.

The SIU has always been trying to perform all the assigned duties and responsibilities accordingly and timely and is going smoothly to achieve the target.

XIII. TRAINING INSTITUTE (TI), AERE

Objectives

The Training Institute (TI) of Bangladesh Atomic Energy Commission (BAEC) is situated in Atomic Energy Research Establishment (AERE) campus, Ganakbari, Ashulia, Savar, Dhaka. It has been built for the Human Resource Development (HRD) for BAEC as well as for the country. The first Nuclear Power Plant (NPP) of Bangladesh is going to be run soon at Rooppur, Pabna. A good number of efficient manpower in different fields will be required in that plant. Besides this, now-a-days different types of radiation sources are being used in different sectors in our country especially for medical, industrial, research and development purposes. Considering all these necessities TI is conducting different kinds of training programs round the year as per the approval of BAEC.

Activities

Followings are the activities performed in the reported period.

1. Training Programs Conducted for the Human Resource Development

Sl. No.	Title of the Event / Training Program	Date	Place	No. of Participants
1.	12 th FTC on Nuclear and Radiological Emergency Preparedness.	10-21 Sept. 2023	TI, AERE	21
2.	11 th FTC on Environmental Radioactivity Monitoring.	29 Oct.- 2 Nov 2023	TI, AERE	18
3.	12 th FTC on Reactor Engineering.	03-14 Dec. 2023	TI, AERE	19
4.	Training Course on PPR-2008 and public Procurement Management-2024	28 Jan.- 08 Feb. 2024	TI, AERE	31
5.	Training course on Official Etiquette and General Behavior-2024	05-07 Mar. 2024	TI, AERE	41
6.	A Brief Orientation Course on Nuclear Science and Technologies for Modern Research (for the young Scientists of BINA)	13-15 May	TI, AERE	30

7.	Radiation Protection for Radiation Workers and RCOs of BAEC, Medical Facilities & Industries-2024	02-06 Jun. 2024	TI, AERE	28
Total				188

2. Attended in Seminar/Symposium/Conference/Workshop/Meeting

Name of the Participants	Title of the Event	Organizer	Date	Place
1. Dr. Ananda Kumar Das	i) Technical meeting on Educational Networks	IAEA	17-21 Jul. 2023	Vienna, Austria
	ii) A Workshop on Innovative Ideas for Building Smart Bangladesh	HRD, BAEC	24 Jun. 2024	BAEC, Head Quarters, Dhaka
2. Mahmudul Hossain	Basic Radiation Knowledge for School Education Course-2023	IAEA, Japan	21 Sept.- 04 Oct. 2023	Ibaraki, Japan

3. Lecture Delivered

Dr. Ananda Kumar Das has delivered following Lectures in different courses held in TI within 2023-24 fiscal years.

- a. Fundamentals of Radiations and Radioactivity
- b. Materials Engineering (Radiation Damage of Materials)
- c. Materials Properties of a Nuclear Power Reactor and its aging effect (degradation).
- d. Natural Disaster Management (Bangladesh Perspective)
- e. National Integrity Strategy (NIS) of Bangladesh
- f. Good Practices etc.

4. Revenue Income

Sl. No.	Source of Income	Income (Tk.)
1.	Dormitory Rent	1,27,500.00
2.	Course Fee	57,000.00
Total		1,84,500.00

Tk. One lac eighty four thousand five hundred only.

XIV. FINANCE AND BUDGET DIVISION (FBD), BAEC HQ**Activities****1. Revenue Budget allocation, Fund Release and Source of Fund**

Code	Head of accounts	Allocation from Govt.	Received from BAEC own income	Total revenue budget
3631101	Salary Support	8988.00	---	8988.00
3631102	Allowance Support	7148.00	---	7148.00
3631103	Goods and Service Support (With Service Charge)	3543.90	8038.73	11582.63
3631104	Pension and Retirement Support	5074.00	---	5074.00
3631108	Research Grant	300.00	101.50	401.50
3631109	Primary Healthcare Services Grant	10.00	---	10.00
3631199	Others Grant	140.00	5296.00	192.96
Sub- total		20129.90	8193.19	208323.09
3632102	Machineries Grant	390.00	420.56	810.56
3632104	Building & Structure Construction Grant	---	---	---
3632105	Information and Communication Technology Grant	10.00	26.00	36.00
3632106	Others Capital Grant	40.00	21.35	61.35
Sub- total		440.00	467.91	907.91
Total		25643.90	8661.10	34305.00

2. Center/ Institute Wise Revenue Budget Allocation

(Taka in lac)

Name of the center/institute	Revenue budget allocation
Bangladesh Atomic Energy Commission, HQ	3666.00
Works Branch, BAEC, Dhaka	266.00
BAERA, Dhaka	375.00
Atomic Energy Centre, Dhaka	2288.00
Atomic Energy Research Establishment, Saver	7340.00
National Institute Of Nuclear Medicine & Allied Sciences, Shahbag, Dhaka	1474.00
Institute Of Nuclear Medicine & Allied Sciences, Chattogram	323.00
Institute Of Nuclear Medicine & Allied Sciences, Rajshahi	331.00
Institute Of Nuclear Medicine & Allied Sciences, Dinajpur	240.00
Institute Of Nuclear Medicine & Allied Sciences, Sylhet	190.00
Institute Of Nuclear Medicine & Allied Sciences, Dhaka	600.00
Institute Of Nuclear Medicine & Allied Sciences, Barishal	245.00
Institute Of Nuclear Medicine & Allied Sciences, Khulna	307.00
Institute Of Nuclear Medicine & Allied Sciences, Rangpur	330.00
Institute Of Nuclear Medicine & Allied Sciences, Mymensingh	455.00
Institute Of Nuclear Medicine & Allied Sciences, Bogura	306.00
Institute Of Nuclear Medicine & Allied Sciences, Cumilla	213.00
Institute Of Nuclear Medicine & Allied Sciences, Faridpur	245.00
Institute Of Nuclear Medicine & Allied Sciences, Mitford	284.00
Institute Of Nuclear Medicine & Allied Sciences, Suhrawardy	115.00
Institute Of Nuclear Medicine & Allied Sciences, Mohakhali	122.00
Institute Of Nuclear Medicine & Allied Sciences, Pabna	114.00
Institute Of Nuclear Medicine & Allied Sciences, Kushtia	118.00
Institute Of Nuclear Medicine & Allied Sciences, Jashore	90.00
Institute Of Nuclear Medicine & Allied Sciences, Cox's Bazar	150.00
Institute Of Nuclear Medicine & Allied Sciences, GopalGanj	110.00
Institute Of Nuclear Medicine & Allied Sciences, Satkhira	106.00
Atomic Energy Centre, Chattogram	292.00
Beach Sand Minerals Exploitation Centre, Cox's Bazar	137.00
Rooppur Nuclear Power Plant, Pabna	120.00
Radioactivity Testing And Monitoring Laboratory, Mongla, Bagerhat	85.00
Foreign Exchange Branch, BAEC, Dhaka	3500.00
Pension Branch, BAEC, Dhaka	5074.00
Service Charge Branch, BAEC, Dhaka	2700.00
Reserve for return to Gov. fund	1994.00
Total=	34305.00

XV. SUPERVISION OF THESIS

ATOMIC ENERGY CENTRE (AEC), DHAKA

Chemistry Division, AECD

1. Supervisor: Dr. Yeasmin Nahar Jolly, "Uptake and distribution of heavy metals in aquatic plant of Karnaphuli River Estuary, Bangladesh ", M.S. Thesis (Fatema Tanjim) Department of Fisheries & Marine Science, Noakhali Science and Technology University , 2023
2. Supervisor: Dr. Yeasmin Nahar Jolly, "Contamination and risk assessment of heavy metals in Silver Pomfret (Pampus argenteus) in the Northern Bay of Bengal", B.Sc. Thesis (Shabbir Ahamed Rony) Department of Marine Fisheries & Oceanography, Patuakhali Science and Technology University , 2023
3. Supervisor: Dr. Yeasmin Nahar Jolly, "Assessment of chromium in poultry feed and products (flesh, liver, bone and gizzard) in Savar sub-district area.", M.Sc. Thesis (Jakia Sultana) Department of Environmental Science, Bangladesh University of Professionals, 2023
4. Supervisor: Dr. Yeasmin Nahar Jolly, "Assessment of heavy metals in Soils and Vegetables collected from the bank of Turag river, Tongi and their possible health risks.", M.S. Thesis (Sharmin Akter, Shamea Akter) Department of Pharmacy, Gono Bishwabidyalay, 2023

5. Supervisor: Dr. Yeasmin Nahar Jolly, “Determining the essential element profiles in some foods commonly consumed during pregnancy.”, B. Pharm Thesis (Farhan) Department of Applied Chemistry and Chemical Engineering, University of Dhaka, 2023
6. Supervisor: Dr. Yeasmin Nahar Jolly, “Heavy metal concentration in tissues of some Marine fish and Shellfish Species collected from the Bay of Bengal, Bangladesh.”, B.Sc. Thesis (Jubaida Akter Binu) Department of Fisheries & Marine Science, Noakhali Science and Technology University, 2023
7. Supervisor: Dr. Yeasmin Nahar Jolly, “Assessment of water quality, heavy metal pollution and DOM dynamics in the water and soil of Tanguar Haor Basin, Bangladesh.”, M.Sc. Thesis (Fariha Ishrar Khan) Department of Environmental Sciences, Jahangirnagar University, 2023
8. Supervisor: Dr. Yeasmin Nahar Jolly, “Assessment of dissolved organic matter (DOM) characteristics in the blue infrastructure of Dhaka city using fluorescence spectroscopy.”, M.Sc. Thesis (Nazifa Tabassum) Department of Environmental Sciences, Jahangirnagar University, 2023
9. Supervisor: Dr. Yeasmin Nahar Jolly, “Assessment of contamination of soil, water, fish due to heavy metals around the different coal fired thermal powerplants in Bangladesh.”, M.Sc. Thesis (Asaduzzaman) Department of Chemistry, University of Dhaka, 2024
10. Supervisor: Dr. Yeasmin Nahar Jolly, “Temporal trends and spatial patterns of heavy metal concentrations in the vicinity of shipbuilding operations along Rupsha river, Bangladesh.”, M.Sc. Thesis (Md. Ahsanul Karim) Department of Oceanography, University of Dhaka, 2024
11. Supervisor: Dr. Yeasmin Nahar Jolly, “Spatial distribution of Arsenic (As) in the accreted land and its potential health impact in the Noakhali coastal region, Bangladesh.”, B.Sc. Thesis (Tabarok Bhuiyan) Department of Oceanography, Noakhali Science and Technology University, 2024
12. Supervisor: Dr. Yeasmin Nahar Jolly, “Spatial distribution of heavy metals [Cr, Pb, Ni, Co, Mn, Fe, Cu, Zn, Cd] in the accreted land and its potential health impact in the Noakhali coastal region, Bangladesh.”, B.Sc. Thesis (Tajrian Meem) Department of Oceanography, Noakhali Science and Technology University, 2024
13. Supervisor: Dr. M. S. Rahman, “Pollution and Health Risk Assessment of Heavy Metals in Roadside Residential Dust with Height Variation in Dhaka City, Bangladesh.”, M. Sc. Thesis (Maria Haider) Jahangirnagar University, 2024
14. Supervisor: Dr. M. S. Rahman, “Bioaccumulation of Heavy Metal in Fishes and Crustaceans from the Karnaphuli River Estuary with Human Health Risk Assessment.”, B. Sc. Thesis (Fariha Khanam Lisa) Noakhali University of Science and Technology, 2024
15. Supervisor: Dr. M. S. Rahman, “Bioaccumulation of Heavy Metal in Crustaceans and Fishes from the lower Meghna River Estuary with Human Health Risk Assessment.”, B. Sc. Thesis (Sayma Tabassum) Noakhali University of Science and Technology, 2024
16. Supervisor: Dr. M. S. Rahman, “A Cemometric Approach of Groundwater Quality for Domestic and Agricultural Use and Health Risk Assessment in Shitkundu Coastal Area, Chattagram, Bangladesh.”, M. Sc. Thesis (A. Hamid Khan Vasani) University of Dhaka, 2024
17. Supervisor: Dr. M. S. Rahman, “Heavy Metal Accumulation and Health Risk Assessment in Aquaculture Fish Collected from BhalukaUpazila in Mymensing.”, M. Sc. Thesis (Nadira Islam) Bangladesh Agricultural University (BAU), 2024
18. Supervisor: Dr. M. S. Rahman, “Occurrence, Spatial Distribution and Characteristics of Microplastics in the Halda River, Bangladesh.”, M. Sc. Thesis (Md. Sahedul) Noakhali University of Science and Technology, 2024
19. Supervisor: Dr. M. S. Rahman, “Distribution of Heavy Metals in the Water and Sediments of the Rabnabad Channel, Patuakhali: A Probabilistic Ecological and Human Health Risk Assessment.”, M. Sc. Thesis (Arnob Ghosh) University of Dhaka, 2023
20. Supervisor: Dr. M. S. Rahman, “Analyzing Heavy Metal Effects on River Sediments in the Sundarbans Mangrove Forest: A Comprehensive Approach to Estimating Heavy Pollution, Ecotoxicity and Human Health Risks.”, M. Sc. Thesis (Afsana Hamid) University of Dhaka, 2023

21. Supervisor: Dr. S. B. Quraishi, “Assesment of essential toxic and trace elements in powder milk in Bangladesh, Ecotoxicity and Human Health Risks.”, M. Sc. Thesis (Md. Abdur Rahman) Department of ANSVM, Potuakhali Science and Technology University (PSTU), 2023
22. Supervisor: Dr. S. B. Quraishi, “Assesment of essential toxic and trace elements in Dairy liquid milk in Bangladesh.”, M. Sc. Thesis (Md. Ashraf Kayser) Department of ANSVM, Potuakhali Science and Technology University (PSTU), 2023
23. Supervisor: Dr. S. B. Quraishi, “Comprehensive analysis of toxic metals and their sources accumulated by fish collected from different habitat in Dhaka, Bangladesh.”, M. Sc. Thesis (Anita Shahriar) Department of Zoology, Jagannath University, 2023
24. Supervisor: Dr. S. B. Quraishi, “Evaluation of heavy metals associated health risk from cooked animal protein source (egg, fish, chicken and beef) in the diet of construction workers in Bangladesh.”, M. Sc. Thesis (Afia Jerin) Environmental Science Discipline, Jahangirnagar University, 2023
25. Supervisor: Dr. S. B. Quraishi, “Assessment of the health risks, bioaccumulation, and source allocation of trace metals in soil and rice of nearby brick kiln industries in the Northern part of Chattogram, Bangladesh.”, M. Sc. Thesis (Abdullah Ali Mahruf) Department of Applied Chemistry and Chemical Engineering, University of Chitagong, 2023
26. Supervisor: Dr. S. B. Quraishi, “Assessment of Water Quality and Heavy metal indices of Tap Water in Dhaka City, Bangladesh.”, B. Sc. Thesis (Tasrif Nur Ariyan) Department of Environmental Science, bangladesh University of Professionals (BUP), 2023
27. Supervisor: Dr. S. B. Quraishi, “Source identification and estimation of antibiotic residues in pultry meat and eggs collected from selected areas of Dhaka and Mymensingh division in Bangladesh”, MPhil Thesis (Amrita Saha Hashi) University of Dhaka, 2023
28. Supervisor: Dr. T. R. Choudhury, “Removal of heavy metals from aqueous solution using agro-waste driven activated carbon and metal phenolic sorbent.”, M.S. Thesis (Saima Alam) Department of Chemistry, University of Dhaka, 2023
29. Supervisor: Dr. T. R. Choudhury, “Efficient Removal of Arsenic (III) from Aqueous Medium Using Bimetallic Biochar (Bagasse-Mn-Al) Synthesized from Sugarcane Bagasse.”, M.S. Thesis (Sajjad Hossain) Department of Applied Chemistry and Chemical Engineering, University of Dhaka, Bangladesh, 2023
30. Supervisor: Dr. T. R. Choudhury, “Evaluation of Heavy Metals in Water, Sediment and Anions in Water Collected from Patenga Sea Beach Area and Sandwip Island and Their Possible Health Risk Assessment.”, M.S. Thesis (Syed Riad) Department of Applied Chemistry and Chemical Engineering, University of Dhaka, Bangladesh, 2023
31. Supervisor: Dr. T. R. Choudhury, “Evaluation of Heavy Metals in Water, Soil, Sediment and Anions in Water Collected from Chittagong Industrial Area and their Possible Health Risk Assessment.”, M.S. Thesis (Foyez Jalal Uddin) Department of Applied Chemistry and Chemical Engineering, University of Dhaka, Bangladesh, 2023
32. Supervisor: Dr. T. R. Choudhury, “Analyzing the Environmental Threshold Level of Toxic Metals for Consumable Seaweed in Bangladesh.”, M.S. Thesis (Kashafad Bin Haifz) Department of Oceanography and Hydregraphy, Bangabandhu Sheikh Muiibur Rahman Maritime university, Bangladesh, 2023
33. Supervisor: Dr. T. R. Choudhury, “Heavy metal concentrations in commercially important spiny lobster species from Bay of Bengal, Bangladesh and preliminary assessment of consumer health risk.”, M.S. Thesis (Rasel Ahmed) Department of Zoology, Jagannath University, 2024
34. Supervisor: Dr. T. R. Choudhury, “Metallic Symphony: A Comprehensive Quantitative Analysis of Heavy Metal Concentrations in Coastal Waters Adjacent to a Coal Fired Power Plant in Bangladesh.”, M.S. Thesis (Md. Farukuzzaman) Department of Fisheries and Marine Science, Noakhali Science and Technology University, 2024
35. Supervisor: Dr. T. R. Choudhury, “Source quantification and pollution level of heavy metals in soil under Different Land Uses in Chilmari Upazila, Northern Bangladesh.”, B.Sc.Thesis (Abdullah AE Yeamim)

Department of Disaster Management , Begum Rokeya University, Rangpur, Bangladesh, 2024

36. Supervisor: Dr. T. R. Choudhury, “Assessing Heavy Metal Hazards in Soil and Plants: A Comparison between Nearby and Remote Areas of Chilai Canal Gazipur.”, B.Sc.Thesis (Sumaiya Tabassum) Environmental Science and Disaster Management, Daffodil International University, 2024
37. Supervisor: Dr. Shirin Akter, “Evaluation of heavy metal contents in spices commonly available in the local market of Bangladesh.”, B.Sc.Thesis (Israt Jahan Resma) Department of Environmental Sciences, Jahangirnagar University, 2023
38. Supervisor: Dr. Shirin Akter, “Determining the trace/toxic element profiles in milk and fish commonly available in different area of Bangladesh.”, B.Sc.Thesis (Evana Akter, SK Kalimullah) Department of Pharmacy, Gono Bishwabidyalay, 2024
39. Supervisor: A. R. M. Tareq, “Composition Formation Mechanism and Optical Properties of Brown Carbon with Chemical Characterization of Atmospheric Fine Particulate Matter in Dhaka, Bangladesh.”, M.S. Thesis (Md. Alamin Hossen) Department of Chemistry, University of Dhaka, 2024
40. Supervisor: Dr. Sushmita Hossain, “Assessment of current pollution condition of the Shitalakhya river and groundwater quality in the adjacent areas.”, M.S. Thesis (Md. Arifur Rahman) Department of Geology, University of Dhaka, 2023
41. Supervisor: Dr. Sushmita Hossain, “Geochemistry of major and trace elements in sediments of Andharmanik River channels.”, B.Sc. Thesis (Jannatul Maoya Piya) Department of Oceanography & Hydrography, Bangabandhu Sheikh Mujibur Rahman Maritime University, 2023
42. Supervisor: Dr. Sushmita Hossain, “Geochemical and Mineralogical Evaluation of Meghna Estuary sediments.”, B.Sc. Thesis (Afrin Rahman Sumoni) Department of Oceanography & Hydrography, Bangabandhu Sheikh Mujibur Rahman Maritime University, 2023

Electronics Division, AECD

43. Supervisor: Dr. Md. Abdullah Al Mamun, “Development of IoT based Soil Quality Monitoring System for Smart Agriculture.”, B.Sc. Thesis (Fahmida Rahman & Arko Mustafi) Dept. of Electrical and Electronics Engineering (EEE), University of Dhaka, 2024

Health Physics Division, AECD

44. Supervisor: Selina Yeasmin, “Comprehensive Analysis of Radioactivity and Radiological Hazards in Soil and Tea Samples from Seven Tea Estates in Sylhet, Bangladesh.”, M.Sc. Thesis (MD. Hossain Kamal) Department of Physics, University of Dhaka, 2023
45. Supervisor: Selina Yeasmin, “Assessment of Radioactivity & Associated Transfer Factors from Soil to Rice in the Samples Collected from Jamalpur, Bangladesh.”, M.Sc. Thesis (Md. Shamim Yeasir Saion) Department of Nuclear Engineering, University of Dhaka, 2023
46. Supervisor: Selina Yeasmin, “Assessment of naturally occurring radioactivity and radiological evaluation of decorative construction materials in Bangladesh.”, M.Sc. Thesis (Md. Shihab Uddin Shuvo) Department of Nuclear Engineering, University of Dhaka, 2023
47. Supervisor: Selina Yeasmin, “Radiological Contamination Investigation of Soils Collected from Major Ship Breaking Yards in Sitakunda, Chattogram, Bangladesh.”, M.Sc. Thesis (Araf Mahmud) Department of Physics, Mawlana Bhashani Science and Technology University, 2023
48. Supervisor: Selina Yeasmin, “Assessment of Elevated Level of Natural Radioactivity of Sand Samples Collected from Various Sea-Beaches in Cox’s Bazar, Bangladesh.”, M.Sc. Thesis (Jannatul Mawa Trishna) Department of Physics, Mawlana Bhashani Science and Technology University, 2023
49. Supervisor: Selina Yeasmin, “The Level of Natural Radionuclides in Ground Water and Health Risk Implication.”, B.Sc. Thesis (Md. Robiul Hasan) Department of Nuclear Engineering, University of Dhaka, 2024
50. Supervisor: Selina Yeasmin, “Radiometric Analysis and Health Risk Evaluation of Soil Samples Surrounding the 1320-megawatt Coal-Fired Maitree Super Thermal Power Project, Rampal, Bagerhat,

Bangladesh.”, B.Sc. Thesis (Sheikh Nafis Haider) Department of Nuclear Engineering, University of Dhaka, 2024

51. Supervisor: Selina Yeasmin, “Examining the Presence of Radioactivity and Health Risk in Soil Samples around the Bheramara 410 MW Combined Cycle Power Plant.”, B.Sc. Thesis (Rajikul Islam) Department of Nuclear Engineering, University of Dhaka, 2024
52. Supervisor: Selina Yeasmin, “Assessment of Natural radionuclides in soil samples collected from industrial areas of Chittagong city, Bangladesh.”, B.Sc. Thesis (Shahidul Islam Shawon) Department of Nuclear Engineering, University of Dhaka, 2024
53. Supervisor: Selina Yeasmin, “Measurement of Radioactivity & Assessment of Radiological Hazard in Soil Samples Collected from Siddirganj Combined Cycle Power Plant, Narayanganj, Bangladesh.”, B.Sc. Thesis (Mehedi Hasan) Department of Nuclear Engineering, University of Dhaka, 2024
54. Supervisor: Selina Yeasmin, “Assessment of Radioactivity and Radiological Hazard in Soil Samples collected from Payra Thermal Power Plant (1320 MW) in Patuakhali, Bangladesh.”, B.Sc. Thesis (Ashik Reza) Department of Nuclear Engineering, University of Dhaka, 2024
55. Supervisor: Selina Yeasmin, “Study of Gross Alpha and Gross Beta Activity in Drinking Water Collected from Manikganj District Using Zinc Sulphide Scintillation Detector (ZnS).”, B.Sc. Thesis (Mukta Halder) Department of Physics, Mawlana Bhashani Science and Technology University, 2024
56. Supervisor: Dr. A. K. M. Mizanur Rahman, “Comparative study of Structural, Thermoluminescence and Kinetic Properties of Ce-doped and undoped LiZnBO_3 for dosimetry application.”, B.Sc. Thesis (Shah Azharul Islam) Department of Physics, Begum Rokeya University, Rangpur, 2023
57. Supervisor: Shikha Pervin, “Measurement of Radon (^{222}Rn) Activity Concentration in Drinking Water of Dhaka City using RAD7 Detector.”, B.Sc. Thesis (Amena Mehazabin) Department of Physics, Mawlana Bhashani Science and Technology University, 2024

Materials Science Division, AECD

58. Supervisor: Dr. Engr. Sheikh Manjura Hoque, “Development of artificially engineered nanoparticles by surface modification and their biomedical applications.”, Ph. D. Thesis (Aminul Islam) Department of Physics, University of Dhaka, Dhaka, 2023
59. Supervisor: Dr. Engr. Sheikh Manjura Hoque, “Synthesis Identification and Optical Properties.”, M. Sc. Thesis (Ashesh Ghosh) Dept .of Materials and Metallurgical Engineering, Bangladesh University of Engineering and Technology, 2023
60. Supervisor: Dr. Md. Mahbubul Haque, “Synthesis and characterization of Cu-Gd co-substituted M-type $\text{SrFe}_{12}\text{O}_{19}$ nanopowder prepared by sol-gel route.”, M. Sc. Thesis (Md. Roni Islam) Department of Physics, University of Rajshahi, Rajshahi, 2023
61. Supervisor: Dr. Md. Mahbubul Haque, “Synthesis of Exchange-spring Coupled $\text{CaFe}_{12}\text{O}_{19}/\text{MnFe}_2\text{O}_4$ Nanocomposites by Co-precipitation Method and Study the Effectiveness of Dexrean Coated Nanocomposites in Hyperthermia for cancer Treatment.”, M. Sc. Thesis (Sharmin Akter Lima) Department of Physics, University of Dhaka, Dhaka, 2023
62. Supervisor: Dr Engr. Sheikh Manjura Hoque, “Correlation of Physico-chemical Properties with SLP and Tmax Attained by RF-indication Heating of Mg- rich Mg-Co Nannoferrite for different Particce Sizes.”, M. Sc. Thesis (Sumi Akter) Department of Physics, University of Dhaka, Dhaka, 2023
63. Supervisor: Dr Engr. Sheikh Manjura Hoque, “Controlled cryspase and morphology: Improving the magnetic, electrical, Optical and photocatalytic activites of Cr-doped SnS_2 nanoparticles synthesized via the hydrothermal method.”, M. Sc. Thesis (Aparna Paul) Department of Physics, University of Dhaka, Dhaka, 2023
64. Supervisor: Dr Engr. Sheikh Manjura Hoque, “Study of the Effect of Different Additive as Sintering Aids on Structural, Microstural, and Magnetic Properties of Mg-Cu-Zn Ferrite.”, M. Sc. Thesis (Motiur Rahman) Department of Physics, University of Dhaka, Dhaka, 2023
65. Supervisor: Dr Engr. Sheikh Manjura Hoque, “Synthesis of Urea-Hydroxyapatite Fertilizer and

Examining Its Efficiency in Boro Rice Cultivation.”, M. Sc. Thesis (Md. Abdullah al Asif) Dept .of Soil Science Bangladesh Agricultural University Mymensingh, 2023

66. Supervisor: Dr. Mohammed Nazrul Islam Khan, “Post Transition Metal Oxides Bi_2MoO_6 and Bi_2CrO_6 for photocataytic Applications .”, M. Sc. Thesis (Shahad Saroar) Dept .of Applied Electrical and Electronic Engineering, University of Dhaka, 2023
67. Supervisor: Dr. Mohammed Nazrul Islam Khan, “An Experimental Look into photocataytic-Bismuth Molybdate.”, M. Sc. Thesis (Sadmin Sultana) Dept .of Applied Electrical and Electronic Engineering, University of Dhaka, 2023
68. Supervisor: Dr. Mohammed Nazrul Islam Khan, “Synthesis, Characterization, and Photodegradation performance of BiPO_4 Polymorphs.”, M. Sc. Thesis (Md.Rafatul Haq & Nusaibah Ehasn) Dept. Electrical and Electronic Engineering, University of Dhaka, 2023
69. Supervisor: Dr. Mohammed Nazrul Islam Khan, “Study on Cobalt and Zinc Doped Manganese Ferrite with Yttrium Substitution to Enhance The Electric, Magnetic and Optical Properties.”, M. Sc. Thesis (Md. Hasibur Rahman) Dept .of Physics , University of Barishal, 2023
70. Supervisor: Dr. Mohammed Nazrul Islam Khan, “Investigation of Structural, Electrical, and Magnetic Properties of the Cobalt, Zinc, and Manganese-Doped Ferrite with Gadolinium Substitution .”, M. Sc. Thesis (Josim Mounsi) Dept .of Physics , University of Barishal, 2024
71. Supervisor: Dr. Md. Al-Mamun, “Comparative Study of structural, Thermoluminescence and Kinetic Properties of Ce-doped and undoped LiZnBo_3 for dosimetry application .”, M. Sc. Thesis (Shah Azharul Islam) Dept .of Physics , Begum RokeyaUniversity Rangpur , 2023
72. Supervisor: Dr. Md. Al-Mamun, “Operating Atomic Absorption Spectrophotometer (AAS) .”, B.Sc. Thesis (Tony Thomas Nokrek) Dept .of Nutrition and Food Engineering , University of Daffodil , 2023
73. Supervisor: Md. Razibul Hasan, “Interplay Between Ferroelectric and Ferromagnetic Phases of Mn Substitued of Multiferroic $\text{Bi}_{0.8}\text{Sm}_{0.1}\text{Dy}_{0.1}\text{Fe}_{1-x}\text{Mn}_x\text{O}_3$ Ceramics.”, M. Sc. Thesis (Mst. Afsana Mimi) Dept .of Physics , University of Jagannath, 2023
74. Supervisor: Dr. Mohammed Nazrul Islam Khan, “Synthesis and Study of Structural, Electrical, and Magnetic Properties of Cobalt-Doped Bismuth Europium Manganese Ferrite .”, M. Sc. Thesis (Farzana Khanam) Dept .of Physics ,Comilla University Comilla, 2024
75. Supervisor: Dr. Mohammed Nazrul Islam Khan, “Investigating Structural, Optical Electrical, and Magnetic Properties of Chromium-Doped Lanthanum Cerium Bismuth Ferrite.”, M. Sc. Thesis (Jahid Hossain Bhuiyan) Dept .of Physics ,Comilla University Comilla, 2024
76. Supervisor: Dr. Engr. Sheikh Manjura Hoque, “Holmium Doping in Bismuth Ferrite: A Comprehensive Characterization and Properties Analysis Synthesis by Sol-Gel Auto Combustiom.”, M. Sc. Thesis (Md. Mohsin Uddin Anik) Department of Physics,University of Chittagong, 2023
77. Supervisor: Dr. Engr. Sheikh Manjura Hoque, “Synthesis and Characterization of Multifuntional Properties of $\text{Bi}_{0.910}\text{Ho}_{0.10}\text{FeO}_3$ with variation of Sintering Temperature.”, M. Sc. Thesis (Umme Maktum) Department of Physics, University of Chittagong, 2024
78. Supervisor: Dr. Engr. Sheikh Manjura Hoque, “Study of the Magnetocaloric Properties and analysis of Critical Behaviour of Cobalt Doped Magnesium spinel Ferrite ($\text{Mg}_{1-x}\text{Co}_x\text{Fe}_2\text{O}_4$) for Magnetic Refrigeration Application.”, M. Sc. Thesis (Shakhawat Hossain) Department of Physics, Comilla University. Cumilla, 2024

Medical Physics Division, AECD

79. Supervisor: Dr. Rajada Khatun, “Assessment of Photon Beam Calculation Algorithm(AAA) Sensitivity to Metallic Implant Artifacts Using a CIRS Thorax Phantom.”, M. Sc. Thesis (Moumita Chowdhury) Department of Medical Physics and Biomedical Engineering, Gono Bishwabidyalay, Savar, Dhaka , 2023
80. Supervisor: Dr. Rajada Khatun, “Metallic Implant Artifacts Impact on Dose Calculation in CIRS Thorax Phantom a Sensitivity Analysis of Lung Tissue.”, M. Sc. Thesis (Prokash Nath) Department of Medical

Physics and Biomedical Engineering, Gono Bishwabidyalay, Savar, Dhaka , 2023

Accelerator Facilities Division, AECD

81. Joint Supervisor: Dr. Md. Joynal Abedin “Assessment of Environmental Toxicity of some Waterfall areas of Bangladesh by PIXE and Radionuclides Detection using Gamma Spectroscopy” PhD thesis (Md. Shafiul Islam), Department of Physics, Jahangirnagar University, 2023.

Plasma Physics Division, AECD

82. Co-supervisor: Dr. Md. Khairul Islam “Optimization of Ion Beam Energy from a Sub-kilojoule Dense Plasma Focus Device using Lee Code M.Sc. (Mst. Rumaya Akter), Physics Discipline, Khulna University, 2023.

INSTITUTE OF NUCLEAR SCIENCE AND TECHNOLOGY (INST), AERE

Nuclear Radiation and Chemistry Division, INST

83. Supervisor: Dr. Md. Ferdous Alam, “Comparison of Physical, Chemical, and Bacteriological quality of Reactor water and Normal Source water” M.S. Thesis, (student’s name: Md. Iftatul Hasan), Department of Nuclear Engineering, Dhaka University., submitted on January 2024.
84. Supervisors:Dr. Nazia Rahman, “Pre-irradiation grafting of acrylonitrile and sodium styrene sulfonate on non-woven polyethylene fabric for efficient removal of crystal violet dye from aqueous solution” M.S. Thesis, (student’s name: S. M. Mobin Sikdar), Department of Chemistry, *Jahangirnagar University.*, submitted on February 2024.
85. Supervisors:Dr. Salma Sultana, M. Saifur Rahaman, “Synthesis, Characterization and Adsorption studies of Kappa carrageenan, poly vinyl pyrrolidone, and N,N-dimethyl acrylamide (KC/PVP/DMA) hydrogel by gamma radiation for removal of Methylene Blue and Congo Red dye from aqueous solution”, M.S. Thesis, (Student name:Sadiya Sultana) Department of Applied Chemistry and Chemical Engineering. Noakhali Science and Technology University, Noakhali., submitted on April, 2024.
86. Supervisors:Dr. Salma Sultana, M. Saifur Rahaman, “Preparation and Characterization of Chitosan (CTS), Acrylamide (AAm), 4-Styrene Sulphonic Acid Sodium Salt (SSS) based hydrogel by Gamma Radiation and its Application for Textile Dyes”, M.S. Thesis, (Student name: Md. Yakub Ali), Department of Applied Chemistry and Chemical Engineering. Noakhali Science and Technology University, Noakhali., submitted on April, 2024.
87. Supervisors:Dr. Salma Sultana, M. Saifur Rahaman, “Synthesis and Characterization of Gamma Radiation Assited Xanthan Gum/Acrylic Acid/Poly-4-Styrene Sulphonic Acid Based Hydrogel and Its Application”. M.S. Thesis, (Student name: Md. Reaz Uddin Chowdhury) Department of Applied Chemistry and Chemical Engineering. Noakhali Science and Technology University, Noakhali., submitted on June, 2024.
88. Supervisors: Dr. Salma Sultana, M. Saifur Rahaman, “Synthesis of carboxymethyl cellulose-N,N-dimethylacrylamide based hydrogel by gamma radiation: Characterization and study of urea fertilizer slow release”, M.S. Thesis, (Student name: Sanket Shill) Department of Applied Chemistry and Chemical Engineering. Noakhali Science and Technology University, Noakhali., submitted on June, 2024.

Health Physics & Radioactive Waste Management Unit(HPRWMU) INST

89. Supervisors: Dr. Md. ShakilurRahman, Hossen Mohammed Jamil, “Spectroscopy and dosimetry of calibration neutron beam by experimental measurement and Monte Carlo N-Particle (MCNP) simulation at SSDL facilities in BAEC.”, M.S. Thesis, (Student name: Md. Hamidul Haque) ChattogramUniversity, Noakhali., submitted on December, 2023.
90. Supervisors: Dr. Md. Mosharrof Hossain Bhuiyan, Hossen Mohammed Jamil, “Study on Thermo luminescence dosimetry in radiotherapy of lung cancer.”, M.S. Thesis, (Student name: Fahima Rahman) GonoBishwabidyalay, Savar, Dhaka., submitted on December, 2023.
91. Supervisors: Dr. Md. Mosharrof Hossain Bhuiyan, Hossen Mohammed Jamil, “Study on radiation dose distribution and risk analysis in radiotherapy of breast cancer by thermo luminescence dosimetry.”, M.S. Thesis, (Student name: Jerin Sultana Sohana) GonoBishwabidyalay, Savar, Dhaka., submitted on December, 2023.

92. Supervisors: Dr. Md. Shakilur Rahman, Hossen Mohammed Jamil, “Dosimetric characterization of small irradiation fields for the Co-60 teletherapy beam with various detectors.”, M.S. Thesis, (Student name: Tanjina Akhter) Chattogram University, submitted on December, 2023.
93. Supervisors: Dr. Md. Shakilur Rahman, Hossen Mohammed Jamil, “Experimental measurement and Monte Carlo N-Particle (MCNP) simulation of 60 kV to 300 kV X-Ray calibration beam at SSDL facilities.”, M.S. Thesis, (Student name: Md. Anisur Rahman) Chattogram University, submitted on January, 2023.
94. Supervisors: Dr. Md. Shakilur Rahman, Hossen Mohammed Jamil, “Dosimetric measurement of therapeutic photon beam by optically simulated luminance (OSL) and thermo luminesce dosimeter (TLD).”, M.S. Thesis, (Student name: Morshida) Chattogram University, submitted on January, 2023.
95. Supervisors: Dr. Shafaly Khatun, Md. Abu Haydar, “Associated Risk Assessment of Radioactivity in Soil, Water and Sediment of Bhairab River Adjacent to the Jashore and Noapara Municipality in Bangladesh.”, M.S. Thesis, (Student name: Antu Das) Jashore University of Science and Technology, Jashore, Bangladesh, submitted on February, 2024.

Reactor Physics and Engineering Division, INST

96. Joint-Supervisor: Dr. Badrun Nahar Hamid, “Simultaneous Effect of RIA-LOFA on TRIGA Mark-II Research Reactor with Probabilistic Approach” M.Sc. Thesis (Md. Zahid Hasan) Department of Physics, Jahangirnagar University, submitted on November 2023.
97. Joint-Supervisor: Dr. Mohammad Abdul Motalab, “Gamma Radiation Dose Estimation of BTRR Burnt Fuel” M.Sc. Thesis (Tahmina Fariha Reza) Department of Physics, Jahangirnagar University, submitted on November 2023.

Isotope Hydrology Division, INST

98. Supervisors: Dr. Md Moniruzzaman, “An Assessment of Environmental Radioactivity and Concentration of Heavy Metals in Soil and Dust Samples around the Buriganga River and Their Potential Public Health Risks in the Area of Southern Dhaka, Bangladesh.”, M.S. Thesis, (Student name: Fatema Rezwana Epty) Department of Environmental Sciences, Jahangirnagar University, submitted on December, 2023.
99. Supervisors: Dr. Md Moniruzzaman, “Environmental Radioactivity Monitoring and Heavy Metal Appraisal in Soil and Sediment Samples in a Heavy Industrial Zone, Narayanganj, Bangladesh.”, M.S. Thesis, (Student name: Hamida Akter) Department of Environmental Sciences, Jahangirnagar University, submitted on December, 2023.
100. Supervisors: Dr. Ratan Kumar Majumder, “Assessment of Natural Radionuclides’ Enrichment in terms of Elemental Compositions in the Municipal Waste Disposal Zone and Industrial Zone (Savar, Bangladesh)”, M.S. Thesis, (Student name: Kazi Md. Masum) Department of Environmental Sciences, Jahangirnagar University, submitted on December, 2023.

INSTITUTE OF ELECTRONICS

Solar Cell Fabrication and Research Division, IE

101. Supervisors: Dr. Ratan Kumar Majumder, “A Study of Fe-doped TiO₂ as an active photo absorbing layer.”, M.S. Thesis, (Student name: Towfikul Islam Tahmid) Department of Physics, Jahangirnagar University, Savar, Dhaka, submitted on November 2023.

INSTITUTE OF ENERGY SCIENCE

102. Supervisors: Mohammad Mizanur Rahman, “Study of Radiological Impact Due to Accidental Release of Significant Radionuclides Considering Various Weather Conditions from the TRIGA Research Reactor of Bangladesh.”, M.S. Thesis, (Student name: Faozia Silvee) Department of Physics, Jahangirnagar University, Savar, Dhaka, submitted on November 2023.
103. Supervisors: Mohammad Mizanur Rahman, “Radiological Dose Assessment for a Hypothetical Accident at RNPP Considering LOCA and LTSBO.”, M.S. Thesis, (Student name: Syed Shajib Hossain) Department of Physics, Jahangirnagar University, Savar, Dhaka, submitted on November 2023.

- 104.** Supervisors: Mohammad Mizanur Rahman, “Atmospheric Dispersion and Radiological Impact Analysis due to a Single Fuel Rod Failure in the TRIGA Mark-II Research Reactor in Bangladesh.”, B.Sc. Thesis, (Student name: Zarin Tasnim Lubna) Department of Physics, Jahangirnagar University, Savar, Dhaka, submitted on June, 2024.

INSTITUTE OF RADIATION AND POLYMER TECHNOLOGY (IRPT), AERE

- 105.** Supervisors: Md. Serajum Manir, “Gamma induced synthesis and characterization of ZnO nanoparticles for photo-catalytic application (Internship).”, B.Sc. Thesis, (Student name: Md. Samiul alam khan) Department of Physics, Jahangirnagar University, Savar, Dhaka, submitted on June, 2024.
- 106.** Supervisors: Md. Serajum Manir, “Gamma induced synthesis and characterization of CuO for photo-catalytic application. nanoparticles (Internship).”, B.Sc. Thesis, (Student name: Rifat Sarkar) Department of Physics, Jahangirnagar University, Savar, Dhaka, submitted on June, 2024.
- 107.** Supervisors: Md. Serajum Manir, “Gamma induced synthesis and characterization of BaO nanoparticles for photo-catalytic application. (Internship).”, B.Sc. Thesis, (Student name: Md. Raiyan Bin Zalat) Department of Physics, Jahangirnagar University, Savar, Dhaka, submitted on June, 2024.

INSTITUTE OF NUCLEAR MINERALS

- 108.** Supervisors: Md Sakaouth Hossain, Mohammad Zafrul Kabir, “Assessment of Heavy mineral enriched sandy sediments characterization from river and beach sand of Bangladesh.”, M.S. Thesis, (Student name: Md. Ariful Islam) Department of Geological Sciences, Jahangirnagar University, submitted on October, 2023.
- 109.** Supervisors: Dr. Abu Sadat Md. Sayem, Dr. Mohammad Rajib, “Sedimentology of the Pleistocene deposits from the Modhupur Tract, Bengal Basin, Bangladesh.”, M.S. Thesis, (Student name: Farhana Tasnim Shifat) Department of Geological Sciences, Jahangirnagar University, submitted on December, 2023.
- 110.** Supervisors: Dr. Abu Sadat Md. Sayem, Dr. Mohammad Rajib, “Grain size and pollen analysis of the Madhupur Formation, Bengal Basin, Bangladesh.”, M.S. Thesis, (Student name: Md. Sourav Rohani) Department of Geological Sciences, Jahangirnagar University, submitted on June, 2024.
- 111.** Supervisors: Dr. Mahfuza Parveen, Dr. Mohammad Rajib, “Constructed wetland design for waste water treatment using aquatic macrophytes.”, B.Sc. Thesis, (Student name: Md. Swadhin Hossain) Department of Environmental Science and Disaster Management, Daffodil International University, submitted on April, 2024.
- 112.** Supervisors: Dr. Mahfuza Parveen, Dr. Mohammad Rajib, “Assessment of Heavy Metals Contamination in Invertebrates from the Cox’s Bazar Coast, Bay of Bengal”, M.S. Thesis, (Student name: Ruhun Nahar Kakon) Department of Geology, University of Dhaka, submitted on July, 2023.

INSTITUTE OF NUCLEAR MEDICAL PHYSICS

- 113.** Co-supervisor: Md. Abul Hasnat, “Radiotherapy Plans and Comparison of Their Dosimetric Efficiency in Head and Neck Cancer Treatment”, M.Sc. Thesis, (Student's name: Mst. Tania Khatun) Master of Science, Department of Physics, Jahangirnagar University, Savar, Dhaka, Bangladesh, submitted on July, 2023
- 114.** Co-supervisor: Md. Abul Hasnat, “Dosimetric Comparison of Three-Dimensional Conformal Radiotherapy and Intensity Modulated Radiotherapy in Carcinoma Lung.” M.Sc. Thesis, (Student's name: Ringkey Islam) Department of Physics, Jahangirnagar University, Savar, Dhaka, Bangladesh, submitted on July, 2023

ATOMIC ENERGY CENTER, CHATTOGRAM

- 115.** Co-supervisor: Dr. AKM Saiful Islam Bhuian, “Measurements Of Heavy Metal Concentrations and Associated Health Risks in Soils of Cumilla District By Systematic Gridding Method.” M.S. Thesis, (Student's name: Mohammad Saeed Hossain) Department of Physics, Chattogram University, July, 2023

INSTITUTE OF FOOD AND RADIATION BIOLOGY (IFRB), AERE

Agrochemical and Environmental Research Division, IFRB

116. Supervisor: Dr. Muhammed Alamgir Zaman Chowdhury, Co-supervisor: Meherun Nesha, “Heavy metals in water, soil, vegetables and fish at the tobacco industrial sites in Rangpur city, Bangladesh: A health risk study.” M.S. Thesis, (Student's name: Rakibul Hasan) Department of Biochemistry and Molecular Biology, Jahangirnagar University., submitted on December, 2023
117. Supervisor: Dr. Muhammed Alamgir Zaman Chowdhury, Co-supervisor: Meherun Nesha, “Assesment of heavy metal content in water, plant, fish and soil samples collected from Dhaleshwari river, Savar, Dhaka.” M.S. Thesis, (student's name: Mahadi Hasan Sohag) Department of Environmental Science, Jahangirnagar University., submitted on December, 2023

Food Safety and Quality Analysis Division, IFRB

118. Supervisors: Dr. Roksana Huque, “DNA barcoding of some yeast isolated from the Sundarban mangrove forest and analysis of their biochemical composition.”, M.Sc. Thesis, (Student name: Jenifer Ahmed) Department of Environmental Science and Disaster Management, Jahangirnagar University, submitted on April, 2023.
119. Supervisors: Dr. Md. Kamruzzaman Munshi, “Application of gamma irradiation for reducing post-harvest losses and quality improvement of potato (*Solanum tubersum* L) to enhance food safety and security.”, M.Sc. Thesis, (Student name: Jahura Akter) Jashore University of Science and Technology., submitted on August, 2023.
120. Supervisors: Mahfuza Islam, “Bio-indicator and Biochemical Analysis of Some Selective Commercially Important Freshwater Fishes of Bangladesh.”, M.Sc. Thesis, (Student name: Sumon Mia) Jahangirnagar University., submitted on November, 2023.
121. Supervisors: Mahfuza Islam, “Comparative Studies on the Gut Histology of *Clarias batrachus*, *Oreochromis niloticus* and *Puntius gonionotus* along with their proximate differentiation.”, M.Sc. Thesis, (Student name: Sumia Kabir) Jahangirnagar University., submitted on November, 2023.

Gamma Source Division, IFRB

122. Supervisors: Dr. Md. Firoz Mortuza, “Determination of phytosanitary gamma radiation dose on Lepidopteran pest, *Leucinodes orbonalis* Guenee of brinjal, *Solanum melongena* L.”, M.Sc. Thesis, (Student name: Md. Abu Sayeed) Department of Zoology, Jahangirnagar University., submitted on May, 2024.

Insect Biotechnology Division, IFRB

123. Co-Supervisors: Dr. Kajla Seheli, “Potential use of *Bacillus subtilis* as a mosquitocidal agent against *Aedes aegypti* mosquito.”, M.S. Thesis, (Student name: Abrar Zaheen Ahmed Bhuiyan) Department of Biochemistry and Microbiology, School of Health and Life Science, North South University., submitted on October, 2023.
124. Co-Supervisors: Dr. Kajla Seheli, “The mosquitocidal activity of locally isolated *Bacillus sphaericus* against *Aedes aegypti*.”, M.S. Thesis, (Student name: Salsabeel Nahar Taib) Department of Biochemistry and Microbiology, School of Health and Life Science, North South University., submitted on October, 2023.

Microbiology and Industrial Irradiation Division, IFRB

125. Supervisors: Dr. Abdullah-Al-Mahin, “Production, Antimicrobial Activity Evaluation and Partial Characterization of Bacteriocin from Fish Gut-Derived *Pediococcus pentosaceus*.”, M.Sc. Thesis, (Student name: Nazma Akter) University of Chittagong., submitted on May, 2024.

Cytology and Biocontrol Research (CBR), READ, IFRB

126. Supervisors: Dr. Farzana Yeasmin & Md. Hasanuzzaman, “Karyology in dipteran insects: Case study of mosquitoes (*Aedes albopictus*) and chironomids (*Chironomus* spp.) in Bangladesh.”, (Student name: Asaduzzaman) M.S. Thesis, Department of Zoology, Faculty of Biological Sciences, Jahangirnagar University, Savar, Dhaka., submitted on November, 2023.
127. Supervisors: Dr. Farzana Yeasmin & Md. Hasanuzzaman, “Cytogenetic analysis in dipteran insects: A

case study in mosquitoes (*Culex quinquefasciatus*) and chironomids (*Chironomus* sp.) from Dhaka city of Bangladesh.”, (Student name: Labiba Tahsin) M.S. Thesis, Department of Zoology, Faculty of Biological Sciences, Jahangirnagar University, Savar, Dhaka., submitted on November, 2023.

128. Supervisors: Dr. Farzana Yeasmin & Md. Hasanuzzaman, “Study on polytene chromosomes of chironomids (Diptera: Chironomidae) from the Jagannath University campus, Dhaka, Bangladesh.”, (Student name: Fahad Hasan) M.S. Thesis, Department of Zoology, Jagannath University, Dhaka., submitted on January, 2024.

Veterinary Drug Residue Analysis Division, IFRB

129. Co-Supervisors: Md Maruf Billah, “Prevalence of Antimicrobial Residues (β -lactam, Tetracycline, Macrolide, Sulfonamide) in Cow Milk Samples from Dhaka District.”, M.Sc. Thesis, (Student name: Sadikur Rahman) Jahangirnagar University., submitted on December, 2023.
130. Co-Supervisors: Darmin Chakma, “Study on the Prevalence of Antimicrobial Residues (β -lactam, Tetracycline, Macrolide, Sulfonamide) in Cow Milk Samples from Khulna Division using Charm II Radioreceptor Assay.”, M.Sc. Thesis, (Student name: Forhad Ibn Awal) Jahangirnagar University., submitted on December, 2023.

INSTITUTE OF TISSUE BANKING AND BIOMATERIALS RESEARCH (ITBBR), AERE

131. Joint-Supervisor: Dr.S.M.Asaduzzaman, “Prevalence of Multidrug-Resistant (MDR) Bacteria in Burn Patients and Efficacy of Radiation Sterilized Human Amniotic Membrane Grafts against the Isolated Bacteria”, M.Sc. Thesis (Md. Nayan Ahmed), Department of Microbiology, Jahangirnagar University, Savar, Dhaka 1342.

NATIONAL INSTITUTE OF NUCLEAR MEDICINE AND ALLIED SCIENCES (NINMAS)

132. Supervisor: Prof. Dr. Shamim Momtaz Ferdousi Begum, Dr. Rashmi Kar, “Assessment of Agreement between Morphologic and Metabolic Response to Platinum Based chemotherapy Assessed by ¹⁸F FDGPET-CT Scan in Advanced Non Small Cell Lung Cance”, MD. Thesis, BSMMU, October, 2023.
133. Supervisor: Prof Dr. Sadia Sultana, Dr. Debobrata Aich Majumder, “Factors Influencing Low Bone Mineral Density in Patients with Type 2 Diabetes Mellitus: Bangladesh Perspective.”, MD. Thesis, BSMMU, July, 2024.
134. Supervisor: Prof. Dr, Nasreen Sultana, Dr. Farida Yeasmin, “Assessment Of Myocardial Perfusion Abnormality Detected By Spect Mpi Among Long Coid Patients: Bangladesh Perspective.”, MD. Thesis, BSMMU, July, 2024.
135. Supervisor: Prof. Dr. Fatima Begum, Dr. Khadijatul Tushra, “Quality of Life and its Associated Factors in Naoioactive Iodine Refractory Differentiated Thyroid Carcinoma Patients.”, MD. Thesis, BSMMU, July, 2024.
136. Supervisor: Dr. Pupree Mutsuddy, Dr. Mashrufa Sultana, “Effects of Long Term TSH Suppressive Dose of Levothyroxine on Bone Mineral Density in Differentiated Thyroid Carcinoma patients after Radioactive Iodine Ablation.”, MD. Thesis, BSMMU, July, 2024.
137. Supervisor: Dr. Zeenat Jabin, Dr. Nasrin Sultana, “Association of Non-Alcoholic Fatty Liver Disease (NAFLD) with Carotid Atherosclerosis Evaluated by B-mode Ultrasonography.”, MD. Thesis, BSMMU, July, 2024.
138. Supervisor: Prof. Dr. Shamim Momtaz Ferdousi Begum, Dr. Shahnaj Hossain Dinu, “RoIe of ¹⁸F FDG PET:CT Scan and MRI for Predicting Pathological Response to Neoadjuvant Chemotherapy in Breast Cancer Management.”, MD. Thesis, BSMMU, July, 2024.
139. Supervisor: Prof. Dr. Fatima Begum, Dr. Sirajum Munira, “Assessment of Effective Dose of Levothyroxine in Treatment of Congenital Hypothyroid Babies: A Pilot Study.”, MD. Thesis, BSMMU, July, 2024.
140. Supervisor: Dr. Sumaiya Alam, “Added value of Wall Thickening score over LVEF in post stress myocardial stunning evaluation by gated SPECT MPI, Prof. Dr. Sadia Sultana.”, MD. Thesis, BSMMU, July, 2024.

141. Supervisor: Prof. Dr. Nasreen Sultana, Dr. Tapasi Sarker, “High Peak Systolic velocity to End-diastolic velocity Ratio (S/D Ratio) of Umbilical Artery Determined by Doppler as a Predictor of Adverse Perinatal Outcome.”, MD. Thesis, BSMMU, July, 2024.
142. Supervisor: Prof. Dr. Nasreen Sultana, Dr. Rumana Parveen, “Association of Vitamin D Level with Myocardial Perfusion Status by Gated-SPECT Myocardial Perfusion Imaging in Patients with Suspected or Diagnosed coronary Artery Diseases.”, MD. Thesis, BSMMU, July, 2024.

INSTITUTE OF NUCLEAR MEDICINE AND ALLIED SCIENCES (INMAS), CHATTOGRAM

143. Co-Supervisor: Dr. Pabitra Kumar Bhattacharjee, “A study of Association of Cytotoxic T-Lymphocytes associated Antigen-4 (CTLA-4) and Protein Tyrosine Phosphatase Nonreceptor type 22 (PTPN22) gene polymorphisms in the patients with Hashimoto’s Thyroiditis in Chattogram, Bangladesh”, M.S. Thesis (Shams Nur Powshi), Department of Genetic Engineering and Biotechnology, University of Chittagong.
144. Co-Supervisor: Dr. Pabitra Kumar Bhattacharjee, “An investigation of genetic correlation between Thyroid Stimulating Hormone Receptor (TSHR) and Forkhead Box Protein 3 (FOXP3) genes and Grave’s disease”, M.S. Thesis (Enayetul Islam), Department of Genetic Engineering and Biotechnology, University of Chittagong.

INSTITUTE OF NUCLEAR MEDICINE AND ALLIED SCIENCES (INMAS), MYMENSINGH

145. Supervisor: Prof. Dr Ratan Kumar Chacraborty, “Association between arteriovenous fistula blood flow and ventricular systolic function in patients with maintenance hemodialysis.a”, MD. Thesis (Dr. Md. Mustafizur Rahman), BSMMU, Dhaka., October 2023.

PLANNING AND DEVELOPMENT DIVISION (PDD), BAEC HQ

146. Joint Supervision: Dr. S. B. Quraishi, “Assessment of essential toxic and trace elements in powder milk in Bangladesh”, M.Sc. Thesis (Student Name: Md. Abdur Rahman), Department of ANSVM, Patuakhali Science and Technology University (PSTU), November, 2023.
147. Joint Supervision: Dr. S. B. Quraishi, “Assessment of essential toxic and trace elements in Dairy liquid milk in Bangladesh”, M.Sc. Thesis (Student Name: Md. Ashraful Kayser), Department of ANSVM, Patuakhali Science and Technology University (PSTU), November, 2023.
148. Joint Supervision: Dr. S. B. Quraishi, “Comprehensive analysis of toxic metals and their sources accumulated by fish collected from different habitat in Dhaka, Bangladesh”, M. S. Thesis (Student Name: Anita Shahriar), Department of Zoology, Jagannathan University, December 2023.
149. Joint Supervision: Dr. S. B. Quraishi, “Evaluation of heavy metals associated health risk from cooked animal protein source (egg, fish, chicken and beef) in the diet of construction workers in Bangladesh”, M. S. Thesis (Student Name: Afia Jerin), Environmental Science Discipline, Jahangirnagar University, December 2023.
150. Joint Supervision: Dr. S. B. Quraishi, “Assessment of the health risks, bioaccumulation, and source allocation of trace metals in soil and rice of nearby brick kiln industries in the Northern part of Chattogram, Bangladesh”, M. S. Thesis (Student Name: Abdullah Ali Mahruf), Department of Applied Chemistry and Chemical Engineering, University of Chittagong, August, 2023.
151. Joint Supervision: Dr. S. B. Quraishi, “Assessment of Water Quality and Heavy metal indices of Tap Water in Dhaka City, Bangladesh”, B. Sc. Thesis (Student Name: Tasrif Nur Ariyan), Department of Environmental Science, Bangladesh University of Professionals (BUP), December 2023.
152. Joint Supervision: Dr. S. B. Quraishi, “Source identification and estimation of antibiotic residues in poultry meat and eggs collected from selected areas of Dhaka and Mymensingh division in Bangladesh”, MPhil Thesis (Student Name: Amrita Saha Hashi), University of Dhaka, August, 2023.
153. Supervisor: Dr. Mohammad Anwar-Ul-Azim, “PET Radiopharmaceuticals Production Procedures in a Medium Energy Cyclotron at NINMAS, Bangladesh.”, B. Sc Engineering Thesis (Student Name: Mymuna Islam, Sumiya Islam and Sunidhi Das Tuli), Department of Nuclear Science and Engineering, Military Institute of Science, February 2024.
154. Co-Supervision: Dr. Mohammad Anwar-Ul-Azim, “Assessment of Effective Dose of Levothyroxine in Treatment of Congenital Hypothyroid Babies: Bangladesh Perspective”, MD (Nuclear Medicine),

Student Name: Dr. Sirajum Munira, National Institute of Nuclear Medicine and Allied Sciences (NINMAS), Bangabandhu Sheikh Mujib Medical University, Shahbag, Dhaka-1000. March 2024.

XVI. INTERNATIONAL NATIONAL PUBLICATION

ATOMIC ENERGY CENTRE (AEC), DHAKA

Chemistry Division, AECD

International:

1. Md Moudud Ahmed, As-Ad Ujjaman Nur, Yeasmin N Jolly, Md Rakeb Ul Islam, Mohammad Saifur Rahman, Shirin Akter, Jimmy Yu, Mohammed Fahad Albeshr, Takaomi Arai, Mohammad Belal Hossain. 2023. Contamination and Ecological Risk Evaluation of Metals in Sediments from a Wetland of International Importance (Ramsar Site), Sustainability, 15, 7753. <https://doi.org/10.3390/su15107753>
2. Mohammad Belal Hossain, Jakia Sultana, Yeasmin N. Jolly, As-Ad Ujjaman Nur, Salma Sultana, Rubel Miazeaa, M. Saiful Islam, Bilal Ahamad Paray, Takaomi Arai, Jimmy Yu. 2023. Seasonal variation, contamination and ecological risk assessment of heavy metals in sediments of coastal wetlands along the Bay of Bengal, Marine Pollution Bulletin, 194, 115337. <https://doi.org/10.1016/j.marpolbul.2023.115337>
3. Shirin Akter, Yeasmin N. Jolly, Jamiul Kabir, Khan M. Mamun, Md. Obidur Rahman, Mehedi Hasan, Mottalib Hossain Sarkar, Bilkis Ara Begum, Md. Joynal Abedin, Saiful Islam Tushar, Shohan M. Fahad, Md. Safiur Rahman & Mayeen Uddin Khandaker. 2023. Heavy metal contamination of surface soils by anthropogenic activities: concomitant ecological and health risk assessment, International Journal of Environmental Analytical Chemistry. . <https://doi.org/10.1080/03067319.2023.2280180>
4. Mohammad Belal Hossain, Md Moudud Ahmed, Yeasmin Nahar Jolly, As-Ad Ujjaman Nur, Salma Sultana, Shirin Akter, Jimmy Yu, Bilal Ahamad Paray, Takaomi Arai. 2023. Potential Toxic Elements and Their Carcinogenic and Non-Carcinogenic Risk Assessment in Some Commercially Important Fish Species from a Ramsar Site, Biology, 12(8), 1072. <https://doi.org/10.3390/biology12081072>
5. Shirin Akter, Yeasmin Nahar Jolly, M.J. Kabir, K.M. Mamun .2023. Analysis of Heavy Metals and Other Elements in Soil Samples for its Physicochemical Parameters Using Energy Dispersive X-Ray Fluorescence (EDXRF) Techniques, Austin Journal of Environmental Toxicology
6. Yeasmin N Jolly, Shirin Akter, M Jamiul Kabir, KM Mamun, M Joynal Abedin, SM Fahad, Arafat Rahman. 2023. Heavy Metals Accumulation in Vegetables and Its Consequences on Human Health in the Areas Influenced by Industrial Activities, Biological Trace Element Research. DOI: [10.1007/s12011-023-03923-6](https://doi.org/10.1007/s12011-023-03923-6)
7. Md Saifur Rahman, Moshir Rahman, Yeasmin N. Jolly, Md Kamal Hossain, Sanjida Afrin Semme, Bilal Ahamad Paray, Takaomi Arai, Jimmy Yu, M. Belal Hossain. 2024. Heavy metals in afforested mangrove sediment from the world's largest delta: Distributional mapping, contamination status, risk assessment and source tracing, Marine Pollution Bulletin, 203, 116429.
h <https://doi.org/10.1016/j.marpolbul.2024.116429>
8. Md. Refat Jahan Rakib, Soab Miah, M. Belal Hossain, Rakesh Kumar, Yeasmin Nahar Jolly, Shirin Akter, Md. Saiful Islam, Abubakr M. Idris. 2024. Delineation of trace metal level in fish feed and farmed fish, Tilapia (Oreochromis mossambicus) and their consequences on human health, Regional Studies in Marine Science, 71, 103403. <https://doi.org/10.1016/j.rsma.2024.103403>
9. Md. Moudud Ahmed, As-Ad Ujjaman Nur, Salma Sultana, Yeasmin N. Jolly, Bilal Ahamad Paray, Takaomi Arai, Jimmy Yu and Mohammad Belal Hossain. 2024. Risk Assessment and Sources Apportionment of Toxic Metals in Two Commonly Consumed Fishes from a Subtropical Estuarine Wetland System, Biology, . 13, 260. <https://doi.org/10.3390/biology13040260>
10. Partho Banik, Md Anisuzzaman, Shovon Bhattacharjee, David J. Marshall d, Jimmy Yu e, As-Ad Ujjaman Nur, Yeasmin N. Jolly, Md Al- Mamun, Bilal Ahamad Parah, Md Maheen Mahmud Bappy, Tabarok Bhuiyan, M. Belal Hossain. 2024. Quantification, characterization and risk assessment of microplastics from five major estuaries along the northern Bay of Bengal coast, Environmental Pollution, . 342, 123036. <https://doi.org/10.1016/j.envpol.2023.123036>

11. A. Begum, S. Nahian, S. Roy, T. R. Choudhury, A. Salam. 2024. Indoor particulate matter exposure and correlation of PM_{2.5} with lung efficacy and SpO₂ level of Dhaka City Dwellers. *Air Quality, Atmosphere & Health*, 1-14. <https://doi.org/10.1007/s11869-024-01586-3>
12. B. A. Begum, R. Raqib, E. Akhtar, M.A. Haq, S. Ahmed, F. Haque, M. A. H. Chowdhury, M. Yunus. 2023. Reduction of household air pollution through clean fuel intervention and recovery of cellular immune balance. *Environment international*, 179, 108137. <https://doi.org/10.1016/j.envint.2023.108137>
13. B. A. Begum, E. Akhtar, S. Ahmed, M.A.H. Chowdhury, S.B. Kader, M.H. Shahriar. 2023. Two years' exclusive use of liquefied petroleum gas (LPG) for cooking reduced household air pollution exposure among rural Bangladeshi women. *The Global Health Network Collections*. <https://doi.org/10.21428/3d48c34a.166575da>
14. S.A. Jahan, Z. Sultana, M.A. Ud-Daula, M. Ashikuzzaman, M.S. Reja, M.M. Rahman, A. Khaton, M.A.K. Tang, M.S. Rahman, H.M. Faruquee, S.J. Lee, A.T.M.M. Rahman. 2024. Optimization of green silver nanoparticles as nanofungicides for management of rice bakanae disease. *Heliyon* 10 (2024) e27579. <https://doi.org/10.1016/j.heliyon.2024.e27579>
15. M.A.M. Siddique, I. Hossain, M.M.R. Sunji, T. Tahsin, T.R. Walker, M.S. Rahman. 2024. Characterization, source identification and hazard index assessment of ingested microplastics in farmed tilapia *Oreochromis niloticus*. *Ecological Indicators* 158 (2023-11-23) 111334. <https://doi.org/10.1016/j.ecolind.2023.111334>
16. M.S. Islam, M.N. Rahman, N.S. Ritu, M.S. Rahman, M.N.I. Sarker. 2024. Impact of COVID-19 on urban environment in developing countries: Case study and environmental sustainability strategy in Bangladesh. *Green Technologies and Sustainability* 2 (2024) 100074. <https://doi.org/10.1016/j.grets.2024.100074>
17. M.A.M. Siddique, A. Uddin, M.S. Hossain, S.M.A. Rahman, M.S. Rahman, G. Kibria, G. Malafaia. 2024. "Microplastic seasoning": A study on microplastic contamination of sea salts in Bangladesh. *Marine Pollution Bulletin* 198, 115863. <https://doi.org/10.1016/j.marpolbul.2023.115863>
18. M.H. Rahaman, M.R. Islam, R. Islam, S.M.N. Alam, M.S. Rahman, M.A. Rahman, B.A. Begum. 2024. Preparation, characterization, and adsorption kinetics of graphene oxide/chitosan/carboxymethyl cellulose composites for the removal of environmentally relevant toxic metals. *International Journal of Biological Macromolecules* 257 (2024) 128357. <https://doi.org/10.1016/j.ijbiomac.2023.128357>
19. S. Kumar, N. Saha, A.A. Mohana, M.S. Hasan, M.S. Rahman, M. Elmes, G.R. MacFarlane. 2024. Atmospheric particulate matter and associated trace elements pollution in Bangladesh: a comparative study with global megacities. *Water, Air, & Soil Pollution (Air Soil Pollut)* (2024) 235:222. <https://doi.org/10.1007/s11270-024-07021-8>
20. M. Rahman, M. Moniruzzaman, K.C. Das, M.A. Islam, M.M. Kamal, M.S. Rahman, R.A. Khan. 2023. Effect of gamma radiation on fungal load decontamination of marketed spices. *Archives of Agriculture and Environmental Science* 8(4): 468 - 475 (2023). <https://doi.org/10.26832/24566632.2023.080402>
21. K. Begum, M.M. Hasan, F. Muhammad, M.A.M. Sarkar, M.S. Rahman, B.A. Begum, A.H.B. Billah, S. Khandker, A.S.M. Mohiuddin. 2023. Ambient Concentration of Particulate Matter PM_{2.5} and Black Carbon: A Comparative Study of Two Different Locations in Dhaka City. *The Open Chemical Engineering Journal*, 2023, Volume 17. DOI: 10.2174/18741231-v17-230228-2022-14
22. M.K.H. Real, M. Varol, M.S. Rahman, A.R.M.T. Islam. 2024. Pollution status and ecological risks of metals in surface water of a coastal estuary and health risk assessment for recreational users. *Chemosphere* 348 (2023-11-22) 140768. <https://doi.org/10.1016/j.chemosphere.2023.140768>
23. M.A. Rahman, M.F. Parvin, M.S. Sarmin, Z. Mawa, K.A. Habib, M.S. Rahman, R. Tasmin, S. Yeasmin, Y. Mahmud, A.M. Idris, R.N. Al-Qathanin, Y.F. Tsang. 2023. Species identification, reproductive biology, and nutritional value of marine shellfish (*Meretrix lyrata*) in the Bay of Bengal. *Marine Environmental Research* 192 (2023) 106222. <https://doi.org/10.1016/j.marenvres.2023.106222>
24. M.S. Sheikh, M.M. Rahman, M.S. Rahman, K. Yildirim, M. Maniruzzaman. 2023. Fabrication of nano composite membrane filter from graphene oxide (GO) and banana rachis cellulose nano crystal (CNC) for

- industrial effluent treatment. *Journal of Industrial and Engineering Chemistry* (in press). <https://doi.org/10.1016/j.jiec.2023.07.048>
25. M.K. Haque, M. Uddin, T. Kormoker, T. Ahmed, M.R.U. Zaman, M.S. Rahman, M.A. Rahman, M.Y. Hossain, M.M. Rana, Y.F. Tsang. 2023. Occurrences, sources, fate and impacts of plastic on aquatic organisms and human health in global perspectives: What Bangladesh can do in future?. *Environmental Geochemistry and Health* 45: 5531–5556 (2023-06-29). <https://doi.org/10.1007/s10653-023-01646-0>
 26. Tasrina R. Choudhury, S. Riad, F. J. Uddin, M. A. Maksud, M. A. Alam, A. M. S. Chowdhury, A. N. Mubin, A. R. M. T. Islam, G. Malafaia. 2024. Microplastics in multi-environmental compartments: Research advances, media, and global management scenarios, *J. Contam. Hydrol.*, 265, 104379
 27. S. Nahian, S. Roy, Tasrina R. Choudhury, B. A. Begum, A. Salam. 2024. Indoor particulate matter exposure and correlation of PM_{2.5} with lung efficacy and SpO₂ level of Dhaka City Dwellers, *Air Qual. Atmos. Health*, <https://link.springer.com/article/10.1007/s11869-024-01586->
 28. S. Ahmed, Tasrina R. Choudhury, M. Z. Alam, M. Nurnabi. 2024. Characterization and application of synthesized calcium alginate-graphene oxide for the removal of Cr³⁺, Cu²⁺, and Cd²⁺ ions from tannery effluents, *Clean Water Rep.*, 1, <https://doi.org/10.1016/j.clwat.2024.100016>
 29. M. M. Kabir, N. Sultana, S M Maleha, R Islam, S Islam, M S Hossain, F Ahmed, Tasrina R Choudhury, M. D. Alam, N. Kabir, N.M Bahadur , L.Tijing, H.K. Shon. 2024. Molecular characterization and human health risk assessment of multi-drug and heavy metals tolerant bacteria from urban river water, *Desalin. Water Treat.*, 317, 100298
 30. Tasrina R. Choudhury, S. F. F.Sowrav, F. N. Jahan, S. Bhowmik, M.Nurnabi. 2024. Enhanced chromium (VI) removal: A remediation study employing nano zero-valent iron supported by sawdust, *J. Environ. Chem. Ecotoxicol.*, 6, 81-91
 31. Tasrina R. Choudhury, S. F. F.Sowrav, S. B. Quraishi, T. Akter, M. S. Rahman, M. A. Alam, A. M. S. Chowdhury. 2024. Appraisal of heavy metal contamination and their source apportionment identification in five river water systems of the coastal areas in Bangladesh, *Reg. Stud. Mar. Sci.*, 70, 103378
 32. F. Y. Nisa, M. A. Rahman, S. Saha, A. M. A.Ahmed, M. K. J. Rafi, F. Sultana, M. Majid, and Tasrina R. Choudhury. 2023. Unraveling Tamarindus indica Pulp-Derived Green Magnesium Oxide Nanoparticles for Cardioprotective Potential against Doxorubicin Induced Cardiomyopathy: A Comprehensive Biochemical and Gene Expression Study, *ACS Omega*, 8 (48), 45626-45644. DOI: 10.1021/acsomega.3c05851
 33. M. Chakraborty, M. M. R.Rahat, Tasrina R. Choudhury, R. Nigar, G. Liu, A. Habib. 2024. Heavy metal contamination and health risk assessment of road dust from landfills in Dhaka-Narayanganj, Bangladesh, *Emerg. Conta.*, 10,
 34. M. B. Hossain, P. Banik, As-Ad Nur, Tasrina R. Choudhury, S. I. Liba, M. F. Albeshr , J. Yu, T. Arai. 2023. Microplastics in fish culture ponds: abundance, characterization, and contamination risk assessment, *Front.envIRON.sci.*, <https://doi.org/10.3389/fenvs>, 1251158
 35. A. Sultana, M. Akhter, Tasrina R. Choudhury, D. Mojumder, K. Nahar, M. S. R. Khan, M. Hasan, AKM Habibullah. 2023. Increase Serum Copper Level in Betel nut Chewer Oral Submucous Fibrosis Patient, *Int. j. adv. multidisc. res. Stud*, 3(3), 989-992
 36. M. Hasan, A. R. M. T. Islam, M. M. F. Jion, M. N. Rahman, S. D. Peu , A. Das , A.B.M.M. Bari , M. S. Islam , S. C. Pal , A. Islam, Tasrina. R. Choudhury, M. R. J. Rakib , A. M. Idris , G. Malafaia. 2023. Personal protective equipment-derived pollution during Covid-19 era: A critical review of ecotoxicology impacts, intervention strategies, and future challenges, *Sci.Total Environ.*, 887(20), 164164
 37. S. F. F. Sowrav, S. M. M. Rahman, M. A. Hossain, K. B. Hafiz , N. I. Hossain , M. N. E. Alam, M. S. Rahman, Tasrina R. Choudhury. 2023. Multi-dimensional approach for an environmental health assessment of a deltaic mangrove ecosystem, Sundarbans, *Environ Adv.*, 12, 100377
 38. M. N. E. Alam, A.K.M.A. Ullah, M.M. Hosen, M.A. Maksud, S.R. Khan, S. Akon, Q. Nahar, F. Jolly, S.B. Quraishi. 2024. Evaluation of essential and trace metals/metalloids distribution and probable human

health risk implications from branded liquid and powder milks available in Dhaka City, Bangladesh, *Biomaterials*. <https://doi.org/10.1007/s10534-023-00574-x>

39. M.T. Islam, M.N.P. Roni, M. Y. Ali, M.R. Islam, M.S.Hossan, M.H. Rahman, A.A.S.M. Zahid, M. N. E. Alam, M.A. Hanif, M.S. Akhtar. 2023. Selectivity of Sol-Gel and Hydrothermal TiO₂ Nanoparticles towards Photocatalytic Degradation of Cationic and Anionic Dyes, *Molecules* 28 (19), 6834
40. M.M. Hosen, M. N. E. Alam, F.S. Tonni, S.R. Khan, M.A. Maksud, L.N.Lutfu, A.K.M. Ullah, R. Begum, Q. Nahar, S.B. Quraishi. 2023. Exploration of Toxic and Essential Metals in Popular Rice Grains of Bangladesh and Associated Human Health Risk Implications, *Biol.Trace Elem.Res.*,202(8), 3851-3867
41. A. Hoque, T.A.Tanbi, N. Saha, S. Ganguli, M. N. E. Alam. 2023. Assessing Trace Metal-Based Human Health Risks for Commonly Used Body Soaps in Bangladesh, *Biol. Trace. Elem. Res.*, <https://doi.org/10.1007/s12011-023-04023-1>
42. A. T. Naziba, M. T. Nafisa, R. Sultana, M. F. Ehsan, A. R. M. Tareq, R. Rashid, H. Das, A. K. M. A. Ullah, A. K. M. Fazle Kibria. 2024. Structural, optical, and magnetic properties of Co-doped ZnO nanorods: Advancements in room temperature ferromagnetic behavior for spintronic applications, *Journal of Magnetism and Magnetic Materials*, Vol. 593, pages171836
43. A. K. M Atique Ullah, M. Akter, A. R. M. Tareq, A. K. M Fazle Kibria, S. H. Firoz. 2024. Deciphering MnOx nanoparticles: A comprehensive analysis reveals Mn₂O₃ as the most cytotoxic variant in cellular systems”, *Materials Letters*, Vol. 355, pages 135520

National

44. M. N. Mondal, D. M. R. H. Siddiqui, I. J. Promi, M. E. Ahsan, Tasrina R. Choudhury, and S. Abrarin. 2023. Water quality and the presence of metals in crustaceans (*Sartorianaspinigera*) and mollusks (*Pila globosa*) close to an urban waste landfill in Kodda at Gazipur, *Annals of Bangladesh Agriculture*,
45. M. N. Mondal, D. M. R. H. Siddiqui, I. J. Promi, M. E. Ahsan, Tasrina R. Choudhury, and S. Abrarin. 2023. Water quality and the presence of metals in crustaceans (*Sartorianaspinigera*) and mollusks (*Pila globosa*) close to an urban waste landfill in Kodda at Gazipur, *Annals of Bangladesh Agriculture*,

Electronics Division, AECD

International

46. A.Begum, M. A. A. Mamun, M. A. Rahman, S. Sattar, M.T. Khatun, S. Sultana, M. Begum. 2024. Effective Stroke Prediction using Machine Learning Algorithms, *Australian J. of Engineering and Innovative Technology*, 6(2), 26-36
47. M. J. Islam, S. Islam, M. T. Khatun, Md. Forhad Hossain, M. J. Rahman, S. Islam. 2024. Exploring the Post-Annealing Influence on Stannous Oxide Thin Films via Chemical Bath Deposition Technique: Unveiling Structural, Optical and Electrical Dynamics, *Intl J. of Innovative Science and Research Technology*, 9, 4, 2874-2880
48. S. Islam K. Fatema, M.R. Sarker, K. Akhtar, A. Begum. 2023. Environmental Sustainability: A Challenge for Leather Industry, *J. of Leather and Footwear* , 23(3), 209-226
49. M. F. Hossain , M. A. Awal , M. J. Islam, M. T. Khatun , S. Islam, M. J. Rahman. 2023. Synthesis and characterization of structural, magnetic and electrical properties of Mn substituted Co-Zn ferrite, *J. of Magnetism and Magnetic Materials*, 588, 171440.
50. M. N. Islam , M. S. Alam , S. Sultana , H. Akhter, M. A. S. Haque. 2023. Design and Development of a PIC Microcontroller Based High Voltage Power Supply, *Intl J. of Trend in Scientific Research and Development (IJTSRD)*, 7, 6

Experimental Physics Division

51. Abdullah Rafsan, Aminur Rahman, SamiaAkter, NymulYeacin, Tania Faruqe, Gautam Kumar Dev, Taehyeong Ha, KhandkerSaadat Hossain, Muhammad Tofazzal Hossain, Md. Abdul Kafi* and Jeong-Woo Choi; *Royal Society of Chemistry*. 2023. Facile synthesis of CuONPs using Citrus limon juice for enhancing antibacterial activity against methicillin-resistant *Staphylococcus aureus*, betalactamase and tetracycline-resistant *Escherichia*, *RSC Adv.*, 13,29363-29375.

52. M.UmmaySumaia, Kazi Hanium Maria*, F.T.Z. Toma, M. A. Zubair and M. T. Chowdhury. 2023. Effect of stabilizer content in different solvents on the synthesis of ZnO nanoparticles using the chemical precipitation method, Heliyon 9 (2023) e20871; published by Elsevier Ltd. <https://doi.org/10.1016/j.heliyon.2023.e20871>.
53. Marefa Tuz Zohora Lima, Tanvir Ahmed Tamim, Fatema Tuz Zohora Toma. 2023. Study of Thyroid Disease in Pregnancy: A Review, A Review. Research & Reviews: A Journal of Life Sciences, 13(3): 33–43p. Publisher: STM Journals.
54. Tania Faruqe. 2024. Green Synthesis Chitosan Nanoparticles for Controlling Multidrug- Resistant mecA- and blaZ- Positive Staphylococcus aureus and A1- positive *e. coli*” International Journal of Molecular Science, 25 4746.

Health Physics Division, AECD

International

55. M.M. Mahfuz Siraz, M.D.A. Rakib, M.S. Alam, J.A. Mahmud, Md. B. Rashid, M.U. Khandaker, M.S. Islam and S. Yeasmin. 2023. Distribution of Radionuclides from Coal-fired Brick Kilns operating on the outskirts of Dhaka City and the consequent Radiological Effects on Human Health and the Environment, Nucl. Eng. Technol., 55(8), 2802-2811.
56. M.M. Mahfuz Siraz, M.S. Alam, J.A. Mahmud, S.C. Das, J. Ferdous, Z. Hossain, S. Das, M.U. Khandaker, D.A. Bradley, S. Tokonami and S. Yeasmin. 2023. The Presence of Carcinogenic Radon in the Padma River Water, adjacent to the Rooppur Nuclear Power Plant, Nucl. Eng. Technol., 55(8), 3046-3053.
57. M.M. Mahfuz Siraz, Md. H. Kamal, Z.H. Khan, M.S. Alam, J.A. Mahmud, Md. B. Rashid, M.U. Khandaker, H. Osman and S. Yeasmin. 2023. Evaluation of Radioactivity in Soil and Rock Samples from an Undiscovered Sea Beach in the Southeastern Coastline of Bangladesh and Associated Health Risk, Environ. Monit. Assess., 195(9),1028.
58. S. Yeasmin, S.K. Das, M.M. Mahfuz Siraz and M.S. Rahman. 2023. Assessing Radioactivity and Hazards: Analysis of Soil, Water, and Coal Samples near a Coal-fired Thermal Power Plant and their Implications for Human Health and the Environment, J. Environ. Anal. Chem., 1-18
59. M.M. Mahfuz Siraz, J.A. Mahmud, M.S. Alam, Md. B. Rashid, Z. Hossain, M.U. Khandaker, D.A. Bradley and S. Yeasmin. 2023. Measurement of radioactivity in soils of Karamjal and Harbaria mangrove forest of Sundarbans for establishment of radiological database, PLoS One, 18 (10), 0289113.
60. M.M. Mahfuz Siraz, M.S. Alam, J.A. Mahmud, Md. B. Rashid, Z. Hossain, E. A. Elrahim, H. Osman, M.U. Khandaker, and S. Yeasmin. 2023. Assessing Radioactivity Levels in Soil Surrounding Steel Production Facilities: A Pioneering Investigation in Bangladesh, J. Environ. Anal. Chem., 1-20
61. M.M. Mahfuz Siraz, J.A. Mahmud, M.S. Alam, Md. B. Rashid, Z. Hossain, H. Osman, M.U. Khandaker, and S. Yeasmin. 2024. Assessment of radioactivity level and associated radiological hazard in fertilizer from Dhaka, Environ. Monit. Assess., 196 (2), 192.
62. J.A. Mahmud, M.M. Mahfuz Siraz, M.S. Alam, Md. J. Dewan, Md. B. Rashid, M.U. Khandaker, H. Osman, N. Tamam & S. Yeasmin. 2024. A Pioneering Study of the Radiological Mapping in the World's Largest Mangrove Forest (the Sundarbans) and Implications for the Public and Environment, Mar. Pollut. Bull., 202, 116349.
63. M.M. Mahfuz Siraz, Md. H. Kamal, Z.H. Khan, M.S. Alam, J.A. Mahmud, Md. B. Rashid, M. U. Khandaker, H. Osman and S. Yeasmin. 2024. Radionuclide Transfer in Tea Cultivation: Assessing Radiological Risks in the largest and first established tea garden in Bangladesh, Soil Sediment Contam., 1-19.
64. M. M. Rahman, M. S. Rahman, M. H. R. Khan, S. Yeasmin. 2023. Assessment of radiation level and potential risk to public living around major hospitals in central and western Bangladesh, Heliyon, 9(9), 1-8.
65. M. R. Rahat, H. A. Mimi, S. A. Islam, M. Kamruzzaman, M. Begum, Md Abul Hasnat, H.A. Abdul-Rashid, Umme Muslima, M. U. Khandaker, D.A. Bradley, Md Al-Mamun, A.K.M. Mizanur Rahman.

2023. Synthesis, characterization and thermo luminescence properties of LiCaPO₄ phosphor for ionizing radiation dosimetry, *Appl. Rad. and Isotop.*, 202,111047.
66. S. A. Islam, M. Kamruzzaman, M. R. Rahat, Shahadat Hossain, H.A. Abdul-Rashid, M. U. Khandaker, D.A. Bradley, Md Al-Mamun, A.K.M. Mizanur Rahman. 2024. LiZnBO₃ phosphor for dosimetry applications, *Rad. Phys. and Chem.*, 218, 111596.
 67. Shikha Pervin, SelinaYeasmin, Mayeen Uddin Khandaker &Afia Begum. 2024. Determination of radon concentration in bottled drinking water of Dhaka City, *Intl. J. Env. Anal. Chem.*
 68. Shikha Pervin, Md Minhaz Kabir, Md Jafor Dewan, Mayeen Uddin Khandaker, SelinaYeasmin. 2024. Evaluation of radioactivity concentration in farm fresh milk and concomitant dose to consumer, *Heliyon*, 1.10 (9).
 69. N. Sultana, S. Pervin, M. J. Dewan, A. M. Apon & S. Yeasmin. 2023. Assessment of annual effective dose from radionuclides in paint materials using High Purity Germanium detector, *Intl. J. Env. Anal. Chem.*1-11
 70. S. Yeasmin, S. K. Das, N. Sultana, M. M. M. Siraz and M. S. Rahman. 2024. Measurement of Environmental Gamma Radiation Dose Rates and Estimation of Radiation Risk near the Construction Site of the Nuclear Power Plant, Indoor and Outdoor Locations of the Research Reactor, and Coal-Fired Thermal Power Plant Area, *J. of Rad. and Nucl. Appli.*, 9 (2), 193-022.
 71. Md Asaduzzaman, Md Mehedi Hassan , Md Kabir Hossain , Md Shahinoor Alam , Mohammad Omar Faruk , and K M Jalal Uddin Rumi. 2024.Transient Analysis of LBLOCA with Subsequent Loss of Offsite Power and Loss of All AC Power in VVER-1200 Reactor,IOP Conf. Series: Mater. Sci. and Eng., 1.1305, 012012.

Materials Science Division, AECD

National/International

72. S.Hossain, M.E. Hossain, S. Islam, M.R.Rana, M.N.I. Khan, G.G. Biswas, M.A. Ali, K. Hoque. 2023. Synthesis of Sr-doped Ni_{0.5} Zn_{0.5} Sr_x Fe_{2-x} O₄ and the study of its structural, mechanical, magnetic, and electrical properties for high-frequency applications, *J. of Physics Open*, 17(6), 100172.
73. M.K. Uddin, N. Deb, R. Rashid, H. Das, I. M. Syed, S. Manjura Hoque. 2023. Physical properties with high specific loss power of magnetite (Fe₃O₄) synthesized via thermal decomposition technique, *J. of AIP Advances*, 13, 105105.
74. N. Deb, R. Rashid, H. Das, I. M. Syed and S. Manjura Hoque. 2023. Enhanced specific loss power of hematite–chitosan nanohybrid synthesized by hydrothermal method, *J. of Royal Society Open Science*, 10, 230384.
75. M. F.-Al-Karim, M. Al Mamun, F. Nahid, M. Ismail, S. Manjura Hoque and M. Mahbubul Haque. 2023. Comparison of structural and antimicrobial activity between graphene oxide and reduced graphene oxide-reinforced hydroxyapatite-based nanocomposites for biomedical application, *J. of Indian Academy of Science*, 46 (212), 1-14.
76. S. K Singha, S. Manjura Hoque, H. Das, A. Alim. 2023. Evaluation of chitosan-Ag/TiO₂ nanocomposite for the enhancement of shelf life of chili and banana fruits, *J. of Heliyon*, 9, 1-14
77. M. I.-Al-Karim, M. Al Mamun, F. Nahid, M. Ismail, S. Manjura Hoque and M. M. Haque. 2023. Comparison of structural and antimicrobial activity between graphene oxide and reduced graphene oxide-reinforced hydroxyapatite-based nanocomposites for biomedical application, *J. of Bull. Mater. Sci.*, 46(212)1-14
78. S. K. Singha, S. Manjura Hoque , H. Das ,M. A. Alim. 2023. Investigation of the structural, magnetic and dielectric properties of NiFe₂O₄/nanoclay composites synthesized via sol-gel autocombustion, *J. of Materials Research and Technology*, 27, 6606-6616
79. S. Nasrin, F.-U.-Z. Chowdhury, M. M.Hossen , A. Islam , A. Kumar, S. Manjura Hoque. 2023. Investigation of the suitability of zinc-doped cobalt ferrite as hyperthermia heating and MRA contrast agent , *J of Materials Research*, 39, 501–520

80. S. Nasrin, M. Moazzam Hossen, F.-U.-Z. Chowdhury, S. Manjura Hoque. 2023. Variation in Structural Properties and Cation Distribution with Zinc Addition in Cobalt Ferrites, *J. of Electronic Materials*, 53, 866–880
81. Q. S. Hossain, S. S. Nishat, M. Sultana, T. A. Mahi, S. Ahmed, M. N. I. Khan, H. N. Das, M. S. Bashar, U. S. Akhtar, S. Jahan, F. Chowdhury, K. S. Hossain, S. M. S. Imran and I. Ahmed. 2023. A combined first principles and experimental approach to Bi_2WO_6 , *J. of Royal Society of Chemistry*, 13, 36130–36143
82. S. Nasrin, F.-U.-Z. Chowdhury, M. M. Hossen, S. Manjura Hoque. 2024. Preparation and analysis of $\text{Mn}_{1-x}\text{Zn}_x\text{Fe}_2\text{O}_4$ nanoparticles coated with chitosan for use as a heating agent and MRI contrast agent in biomedical applications, *J. of Magnetism and Magnetic Materials*, 594, 171891.
83. A. Ghosh, M. Zaheen, A. Islam, M. S. Rahman, A. Sharif and S. Manjura Hoque. 2024. Enhancement of coercivity in polybenzoxazine/ $\text{Co}_x\text{Mg}_{1-x}\text{Fe}_2\text{O}_4$ nanoferrite composites: Synthesis and characterization, *J. of AIP Advances*, 14 (2024), 015354
84. M.S. Islam, S. Manjura Hoque, M. Rahman, M. R. Islam, A. Irfan and A. Sharif. 2024. Superior Cyclic Stability and Capacitive Performance of Cation- and Water Molecule-Preintercalated $\delta\text{-MnO}_2/\text{h-WO}_3$ Nanostructures as Supercapacitor Electrodes, *J. of ACS OMEGA*, 9, 9, 10680–10693
85. M. Aminul Islam, Ishtiaque M. Syed, M. Al Mamun and S. Manjura Hoque. 2024. Effect of particle size and composition on local magnetic hyperthermia of chitosan- $\text{Mg}_{1-x}\text{Co}_x\text{Fe}_2\text{O}_4$ nanohybrid, *J. of Frontiers in Chemistry*, 12, 1347423
86. Ishtiaque Syed, Sharmin Akter Lima, Nandita Deb, M. Al-mamun and Sheikh Manjura Hoque. 2024. Performance evaluation of dextran-coated $\text{CaFe}_{12}\text{O}_{19}/\text{MnFe}_2\text{O}_4$ exchange-spring composites for the self-heating properties at radio frequency field, *J. of Frontiers in Chemistry*, 12, 1347113
87. Md. Shafayat Islam, Koushik Roy Chowdhury, Sheikh Manjura Hoque and Ahmed Sharif. 2024. Cationic and Oxygen defect modulation for tailoring the bandgap and room temperature ferromagnetism of CuO via multiple d-block cations, *J. of Materials Advances*, 5, 2946-2967
88. Faizul Mohammad Kamal and Sheikh Manjura Hoque. 2024. Controlling Fabrication of Aluminum Micromaterials by Electromigration Using a Thin-film Line with a Sudden Change in Geometrical Shape, *Journal of Electrical and Electronics Engineering (IOSR-JEEE)* 19, 38-46
89. Mohammad Mostafa Raja, Rabiul Awal, Jahirul Islam Khandaker, Mohammad Al-Mamun, Mohammad Mahbubul Haque, Nilufer Yesmin Tanisa, Mohammad Sheikh Farid, Sayed Muhammad Shahid Hasan, Shamima Meherin. 2023. HAP/f-MWCNTs/Cobalt Ferrites Nano Composites Synthesis and Electrical and Magnetic Performance Investigation, *Open Access Library Journal*, 10, 1-15
90. Atanu Sarker Jyoti, G. G. Biswas, Md. Rasel Rana, Shariful Islam, Md. Emran Hossain, Nazrul Islam Khan, K. Hoque, Md. Ashraf. 2023. Investigation of the structural, electrical and magnetic properties of vanadium substituted Mn-Zn ferrites, *J. of Discover mater.* 3, 20
91. Md. Zarif Hossain, Sadiq Shahriyar Nishat, Shahrar Ahmed, Quazi Shafayat Hossain, M. N. I. Khan, Tarique Hasan, Muhammad Shahrar Bashar, A. K. M. Sarwar Hossain Faysal, Ishtiaque M. Syed, Khandaker Saadat Hossain, Sakawat Hussain, Md. Mosaddek Khan and Imtiaz Ahmed. 2023. Combined experimental and DFT approach to BiNbO_4 polymorphs, *J. of RSC Advances*, 13, 5576-5589
92. Nazia Khatun, Sajib Ahmed, Mohammad Sajjad Hossain, Syed Farid Uddin Farhad, Md Al-Mamun, Mohammad Saiful Alam, Most Hosney Ara Begum, Nazmul Islam Tanvir, Mahmuda Hakim, Suravi Islam. 2023. Influence of Y^{3+} and La^{3+} ions on the structural, magnetic, electrical, and optical properties of cobalt ferrite nanoparticles, 9, 13019
93. Md. Roni Islam, M. K. R. Khan, Md. Sarowar Hossain, M. M. Rahman, M. Mahbubul Haque, M. Aliuzzaman, M. K. Alam and M. S. I. Sarker. 2024. Structural, thermodynamic, and magnetic properties of $\text{SrFe}_{12}\text{O}_{19}$ hexaferrite modified by co-substitution of Cu and Gd” *J. of RSC Advances*, 14, 7314 - 7328
94. Partho Banik, Md Anisuzzaman, Shovon Bhattacharjee, David J Marshall, Jimmy Yu, Asad Ujjaman Nur, Yeasmin N Jolly, Md Al- Mamun, Bilal Ahamad Paray, Md Maheen Mahmud Bappy, Tabarok

Bhuiyan, M Belal Hossain. 2024. Quantification, characterization and risk assessment of microplastics from five major estuaries along the northern Bay of Bengal coast, *J. of Environmental Pollution*, 342, 123036

95. Bishal Sharker, Md. Aminul Islam, Md. Al Amin Hossain, Iqar Ahmad, Abdullah Al Mamun, Sibdas Ghosh, Aminur Rahman, Md. Shohorab Hossain, Md. Ashikujjaman Ashik, Md. Rayhanul Hoque, Md. Khalid Hossain, M Al Mamun, Md. Atiqul Haque, Harun Patel, Md. Yeasin Prodhan, Prosun Bhattacharya, Md. Azizul Haque. 2023. Characterization of lignin and hemicellulose degrading bacteria isolated from cow rumen and forest soil: Unveiling a novel enzymatic model for rice straw deconstruction, *J. of the Total Environment*, 904, 166704
96. Md Al-Mamun, Jinhu Chen, Marek Burda, Krzysztof K. Koziol. 2023. Phase and orientation effects in X-ray attenuation of carbonaceous epoxy composites, *J. of Materials Chemistry and Physics*, 309, 128318

Medical Physics Division, AECD

International

97. F. Islam, K. A. Khan, M. S. Hossain, S. R. Rasel and S. Akter. 2023. Studies on Synthesis, Characterization, and Monitoring of Ag NPs for Power Production Using Tomato, Springer Nature Singapore Pte Ltd., pp. 73-85.
98. M. H. Uday, R. Khatun, M. Rahman, F. Rabby and S. Akter. 2023. Dosimetric verification of radiotherapy treatment planning system at TMSS Cancer Center, Bogura, Bangladesh” *World J. of Advanced Engineering Technology and Sciences*, Vol. 10(02), pp. 120–126.

National

99. S. Akter, R. Khatun, S. M. E. Kabir, A. N. Monika, M. F. Uddin, M. M. Rahman, M. M. Ahasan. 2023. Dosimetric Verification of Computed Tomography (CT) System Using CTDI Phantom”, *Bangladesh J. of Nuclear Medicine*, 26 (2): 172-17.
100. N. Monika, R. Khatun, S. Akter, M. A. Hasnat, M. M. Rahman, M. M. Ahasan. 2024. “A Comparison Study of the Solid Phantom and Water Phantom Using 6 MV and 15 MV Photon Energies, Depending on the Depth”, *Bangladesh J. of Nuclear Medicine*, 27(1): 34-38.

Non-Destructive Testing Division, AECD

National

101. M. F. H. Chowdhury. 2024. NDT for Assurance of Quality & Safety of Mega Projects: Keynote Speech, BSNDT NDT Proceeding, Vol. 2, 01-06
102. M. S. Alam. 2024. Modern NDT Methods for Ensuring Quality & Safety, BSNDT NDT Proceeding, Vol. 2, 09-20
103. M. F. H. Chowdhury. 2024. Certification Requirements for NDT Practitioners, BSNDT NDT Proceeding, Vol. 2 (), 21-33

Accelerator Facilities Division, AECD

International

104. Shirin Akter, Yeasmin N. Jolly, Jamiul Kabir, Khan M. Mamun, Md. Obidur Rahman, Mehedi Hasan, Mottalib Hossain Sarkar, Bilkis Ara Begum, Md. Joynal Abedin, Saiful Islam Tushar, Shohan M. Fahad, Md. Safiur Rahman & Mayeen Uddin Khandaker. 2023. Heavy metal contamination of surface soils by anthropogenic activities: concomitant ecological and health risk assessment, *International Journal of Environmental Analytical Chemistry*, <https://doi.org/10.1080/03067319.2023.2280180>

Plasma Physics Division, AECD

105. M. S. Munir, M. K. Islam, M. A. H. Talukder, M. Salahuddin. 2024. Instability of dust-lower-hybrid mode in irradiated streaming dusty plasma with dust charge fluctuation, *Plasma Physics and Technology*, Accepted on June 28

CENTRE FOR RESEARCH REACTOR (CRR), AERE

National/International

106. Md. Rosaidul Mawla, Anisur Rahman, Abdus Sattar Mollah, Radmim Ryeen, Md. Shafiqul Islam. Assessment of radiological consequences to a hypothetical accident of the 3-MW TRIGA Mark-II nuclear research reactor of Bangladesh, Nuclear Engineering and Design, 424, 113255.
107. M. Ajijul Hoq, M. A. MalekSoner, S. Khanom, M. J. Uddin, M. Moniruzzaman, M. S. H. Chowdhury, A. Helal, M. Abu Khaer, S. M. T. Hassan, M. Tareque Chowdhury, and M. Mizanur Rahman. 2024. Assessment of Radiation Dose Associated with the AtmosphericRelease of⁴¹Ar from the TRIGA Mark-II ResearchReactor in Bangladesh, Science and Technology of Nuclear Installations, 1-14.

INSTITUTE OF NUCLEAR SCIENCE AND TECHNOLOGY (INST), AERE

Radioisotope Production Division, INST

International

108. F. T. Jahura, F. K. Ferdousi, M. Q. Ehsan, and M. A. Hossain. 2024. SEM Evaluation to Optimize the Conditions for Producing Uniform Chitosan Nanoparticles from Shrimp Shells that can Effectively Adsorb Acid Red 1, *Eur. Chem. Bull.* 13(Regular Issue 01), 443 – 455.
109. A. K. Roy, W. Ghann, S. Rabi, J. Barua, S. Majumder, R. Amin, M. K. M. Z. Hyder and J. Uddin. 2024. Hydrogen peroxide assisted synthesis of fluorescent carbon nanoparticles from teak leaves for dye-sensitized solar cells, *RSC Sustainability*, 2, 1003–1013.
110. S. M. A. Hasan, M. Hossain, M. Moniruzzaman, M. M. Billah, M. S. H. Chowdhury, R. Amin, M. R. Parven, and M. O. Islam. 2023. Techniques, Methods, and Analysis of Text Mining: A Review, *I. J. Mat. Mathe. Sci.*, 5(2), 09-15.
111. S. M. A. Hasan, M. Billah, M. Moniruzzaman, M. M. Billah, M. S. H. Chowdhury, R. Amin, M. R. Parven, and M. O. Islam. 2023. Chemical Attack on Concrete in Wastewater Treatment Plant: A Review, *Aust. J. Eng. Inn. Tech.*, 5(5), 192-205.

Nuclear Radiation and Chemistry Division, INST

International

112. Md. Samsur Rahaman, Md. Saifur Rahaman, Sh. Md. MarzukHasnine, Salma Sultana, Md. Abdul Quaiyum Bhuiyan, Mohammad Shahriar Kabir, Md. Abdul Bari, Jahid Md. Mahbub Istam, Md. Ismait Hossain, Mubarak Ahmad Khan. 2024. Evaluation of In Vitro Antimicrobiat, Cytotoxic, Thrombolytic, and Antiarthritic Property of Different Parts of Bari orchid, Evidence-Based Complementary and Alternative Medicine, <https://doi.org/10.1155/2024/8148610>.
113. M. S. Rana, N. Rahman, T. A. Chowdhury, N. C. Dafader, S. Sultana, M. N. Sardar, M. N. Kayser. 2023. Investigations of applicability of sulfonated-GMA-g-non-woven PE, adsorbent for the efficient removal of uranium from aqueous solutions, *J. Radioanal. Nucl. Chem.*, Vol 332(3), pp 737–746, <https://doi.org/10.1007/s10967-023-08802-x>
114. P. Majumder, N. Rahman, S. Sultana, M. N. Sardar, D. C. Shil, M. A. Alam. 2023. Synthesis and Characterization of Poly(vinylpyrrolidone) / Starch / Dimethylacrylamide Hydrogel by Gamma Radiation and Its Application in Basic Fuchsin and Methyl Orange Removal, *Int. J. Polym. Sci. Eng.*, Vol 9 (2) pp 1-20, DOI (Journal): 10.37628/IJPSE
115. M.F. Alam, Z.A. Begum, Y. Furusho, H. Takata, I.M.M. Rahman. 2023. Study on separation of Rhenium, a surrogate element of fissiogenic technetium, from aqueous matrices using ion-selective extraction chromatographic resin, *Separation*, 10, 216.
116. D. C. Shil, N. Rahman, S. Sultana, M. N. Sardar, P. Majumder, F. N. Robel. 2023. Preparation & Characterization of Polyvinyl Alcohol-Sodium Alginate-Starch Based Hydrogel by Gamma Radiation and Its Application for the Treatment of Dye Containing Water, *Adv. Environ. Eng. Res.*, Vol 4(4). pp 1-19. doi:10.21926/aeer.2304048
117. S. Sultana, N. Rahman, M. N. Sardar, A. K. M. A. Hossain. 2023. Preparation of a Novel Proton Exchange Membrane Using Radiation Grafted ETFE Film for Fuel Cell, *J. Appl. Membrane Sci. Technol.*, Vol 27(3),: 81–95. DOI: <https://doi.org/10.11113/amst.v27n3.276>

118. S. Ahmed, A. Shahriar, N. Rahman, M. Z. Alam, M. Nurnabi. 2024. Synthesis of gamma irradiated acrylic acid-grafted-sawdust (SD-g-AAc) for trivalent chromium adsorption from aqueous solution, *J. Hazard. Mater. Adv.*, Vol 14, 100427, <https://doi.org/10.1016/j.hazadv.2024.100427>
119. S. Sultana, S. M. M. Sikder, N. Rahman, M. N. Sardar, S. K. Sen, S. S. Rini, M. M. Mila. 2024. Adsorption of Cu (II) ions from the aquatic environment using pre-irradiated Ethylene Tetrafluoroethylene Film, *Appl. Chem. Eng.* Vol 7 (1), doi: 10.24294/ace.v7i1.2234
120. N. Rahman, N. C. Dafader, S. Sultana, M. N. Sardar, Chapter 16, “Chemical and Radiation Modification of Gelatin” In: M. S. Sreekala, L. Ravindran, K. Goda, S. Thomas (Eds.), “Handbook of Natural Polymers, Volume 2”. 2024, Elsevier (WOODHEAD publishing, UK) –pp 267-300. <https://doi.org/10.1016/B978-0-323-99856-7.00012-4>
121. N. Rahman, N. C. Dafader, R Rahman, M. I. H. Mondal, Chapter 19, “Smart medical clothing for disabled and aged people”, In: M. I. H. Mondal (Ed.), “Smart Textiles from Natural Resources”, Elsevier (WOODHEAD publishing, UK), 2024, pp 587-639, <https://doi.org/10.1016/B978-0-443-15471-3.00023-6>
122. B.M. Khan, M.F. Alam, Z.A. Begum, I.M.M. rahman. 2024. Growth Responses of *Holcus lanatus* L. (Velvet Grass) in Soils Contaminated with Cesium or Strontium, *Soil System*, 8, 57.
123. M. I. H. Mondal, N. Rahman, M. N. Pervez, M. K. Islam, M. A. Habib, F. Ahmed, Chapter 5, “Nanotechnology for smart textiles—recent development and applications”, In: M. I. H. Mondal (Ed.), “Smart Textiles from Natural Resources”, Elsevier (WOODHEAD publishing, UK), 2024, pp 143-187, <https://doi.org/10.1016/B978-0-443-15471-3.00012-1>
124. Md. Abdur Razzaq, M. Mahfujur Rahman, Md. Motinur Rahman and Md. Salamat Ullah. 2024. Sky Fruit Seed Crush (SFSC): A Potential Source of less Salt Curing of Raw Goatskin, *Journal of American Leather Chemists Association. JALCA*, VOL. 119, pp. 247-254, DOI: <https://doi.org/10.21203/rs.3.rs-2867777/v1>

Health Physics & Radioactive Waste Management Unit(HPRWMU) INST

International

125. M. Ummeyb Habiba Musfika, Hossen Mohammad Jamil, Md. Shakilur Rahman, AKM Moinul Haque Meaze. 2023. Measurement of photoneutron dose rate for 15 MV photon beam from medical linear accelerator using neutron survey meter. *Diagnostics and Therapeutics*, Vol:2, 34 – 40.
126. Hossen, M. J., Haydar, Md. A., Rahman, Md. A., Ali, Md. I., Paul, D., Asaduzzaman, K., ... M. U. Khandaker. 2024. Committed effective dose due to the intake of medicinal plants and herbs by the Bangladeshi populace. *International Journal of Environmental Analytical Chemistry*, 1–13. <https://doi.org/10.1080/03067319.2024.2359647>.
127. M. F. Uddin, M. Begum, M. Ahmed, M. Atiquzzaman, H. Osman, N. Tamam, A. Sulieman, S. Akter, and M. U. Khandaker. 2024. Radiation Safety and Shielding Evaluation of Newly Installed Medical LINAC Facility in Bangladesh, *Journal of Radiation Research and Applied Sciences* 17, 100844.
128. K. Asaduzzaman, I. A. Mou, Kamrunnar, M. E. Haque, M. K. Munshi and M. A. Hossen. 2024. Radiological characterization of freshwater fish species from strategic locations in Bangladesh. *Radiation Effects and Defects in Solids* (Accepted).

National

129. S. Akter, R. Khatun, S. M. E. Kabir, A. N. Monika, M. F. Uddin, M. M. Rahman, M. M. Ahasan. 2023. Dosimetric Verification of Computed Tomography (CT) Systems Using CTDI Phantom. *BJ of Nuclear Medicine*, 26(2), 172-176. <https://doi.org/10.3329/bjnm.v26i2.1488>

Internal Reports

130. M. F.Uddin, B.C. Sutradhar, M. H. Rahman and M. A. Rahim. “Radiation level on the empty container type B(U) surface”. During the reporting period (July 2023 – June 2024) such kind of 40 radiation survey work has been performed.

131. M. Ahmed, B.C. Sutradhar, “Inspection, collection, transportation, and interim storage of Am-241 radioactive source at Central Radioactive Waste Processing and Storage Facility (CWPSF) from the detention area of Mega Port Initiative, Chattogram Seaport, Chattogram”. HPRWMU-40/2023, September 2023.
132. Dr. K. Assaduzzaman, M.A. Haydar, M. A. Rahim, “Recovery and safe storage of radiation source from container no. TCKU-1130674 × 20’ containing ‘Ferrous waste and scrap consisting of HMS/P and S MIX’ of S. S. Steel Ltd. detained at Chattogram sea port, Chattogram”. HPRWMU-44/2023, September 2023.
133. Dr. M. M. H. Bhuiyan, S. Paul, B.C. Sutradhar, “Inspection, collection, transport and interim storage of fission chambers of BTRR, CRR, AERE to CWPSF”. HPRWMU-45/2023, October 2023.
134. M.A. Rahman, “Inspection, collection, transportation and interim storage of Ni-63 source at Central Radioactive Waste Processing and Storage Facility (CWPSF) from Uttara Model Town, Sector-6, Dhaka”. HPRWMU-46/2023, October 2023.
135. Dr. M. M. H. Bhuiyan, S. Paul, B.C. Sutradhar, “ Physical inspection and radiation survey of Tangential Beam Port (TBP) of BAEC TRIGA Research Reactor(BTRR)”. HPRWMU-52/2023, October 2023.
136. Dr. K. Assaduzzaman, M.H. Rahman, “Inspection, collection, transportation and interim storage of Cs-137 source at Central Radioactive Waste Processing and Storage Facility (CWPSF) from scrap container of S.S. Steel Ltd. detained at Chattogram sea port, Chattogram”, HPRWMU-53/2023, October 2023.
137. Dr. K. Assaduzzaman, M.H. Rahman, “Inspection report on disused sealed radioactive Ir-192 sources of Ideal NDT Service and Training Centre house-12, road-28, block-D, section-10, Mirpur, Pallabi, Dhaka-1216”. HPRWMU-57/2023, November 2023.
138. Dr. M. M. H Bhuiyan, M H Rahman, “Physical inspection and radiation survey of two condemned Linear Accelerator Machines of Radiation Oncology Division, National Institute of Cancer Research & Hospital (NICRH), Mohakhali, Dhaka”. HPRWMU-58/2023, November 2023.
139. Dr. K. Assaduzzaman, B.C. Sutradhar, “Radiation safety status of the newly installed Brachytherapy machine (Flexitron Cobalt-60) at Department of Radiotherapy, Shaheed Ziaur Rahman Medical College Hospital (SZMCH), Bogura, Bangladesh”. HPRWMU-61/2023, November 2023.
140. S. Paul, B.C. Sutradhar, M.H. Rahman, “Measurement of radiation dose levels around the ⁶⁰Co-irradiator facility of Gamma Source Division at the Institute of Food and Radiation Biology (IFRB), AERE, Savar, Dhaka”. HPRWMU-62/2023, December 2023.
141. M. F. Uddin, M. A. Rahim, “Radiation Safety Status of the newly Installed Brachytherapy Machine (Flexitron cobalt-60) at department of Radiation Oncology Division, National Institute of Cancer Research & Hospital (NICRH), Mohakhali, Dhaka. Bangladesh”, January 2024.
142. S. Paul, B.C. Sutradhar, “Radiation safety status of the newly installed High Frequency Mobile C-arm System at Department of Surgical Oncology, National Institute of Cancer Research and Hospital (NICRH), Mohakhali, Dhaka, Bangladesh”, March 2024.
143. M.H. Rahman, M. A. Rahim, “Transportation and interim storage of disused sealed Ir-192 radioactive sources and 03 units of gamma ray exposure projectors of model Techops-660 at Central Radioactive Waste Processing and Storage Facility (CRWPSF) from Engineering Inspection Services of Bangladesh Limited (EISB), Ashulia, Savar, Dhaka“, May 2024.
144. Dr. K. Asaduzzaman, M. H. Rahman, “Transportation, and interim storage of disused sealed Ir-192 radioactive sources at Central Radioactive Waste Processing and Storage Facility (CRWPSF) from Ideal NDT Service and Training Centre, Pallabi, Mirpur, Dhaka“, May 2024.
145. M. F. Uddin, M. H. Rahman, M. A. Rahim, “Tertiary inspection report on detection of radioactive material (s) in containers no. PCIU-0170820×20’ and RFCU-2008460×20’ containing Zinc Oxide (ZnO), detained at Chattogram sea port, Chattogram”, May, 2024.

Reactor Physics and Engineering Division, INST

International

146. S. M. Shauddin. 2023. Optimizing Neutronic and Photonic Performance in Irradiation Systems of Symmetric TRIGA Cores, Atom Indonesia Vol. 49, No. 2, P.P.89-95.
147. S. M. Shauddin. 2023. Radial power distribution optimization for the VVER-1000 initial core loading pattern, International Journal of Nuclear Energy Science and Technology (IJNEST), Vol. 16, No.3, PP.206-215.

Tandem Accelerator Facilities Division, INST

International

148. M.S. Uddin, S. Sudár, M. S. Basunia, B. Scholten, S. Spellerberg, A. S. Voyles, J. T. Morrell, I. Spahn, A. Hermanne, L. A. Bernstein, B. Neumaier, S. M. Qaim. 2024. Excitation functions and isomeric cross-section ratios of (d,xn) reactions on ^{86}Sr , European Phys. Jour. A, 60 (6), 128
149. M. M. Hasan, M. S. Uddin, A. K. Chakroborty and M. S. Basunia. 2024. Activation cross sections for the formation of ^{51}Cr and $^{52,54}\text{Mn}$ in interactions of deuterons with iron, Radiochim. Acta, 112 (3), 141-147
150. M. S. Uddin, M. M. Uddin, R. Khan, M. M. Hasan, M. A. Shariff, M. O. Rahman and S. M. Qaim. 2023. Measurement of spectrum-averaged cross sections of the (n,p) and (n,n') reactions on strontium by fast neutrons of a TRIGA reactor: comparison with integrated data from excitation functions of various data libraries, Radiochim. Acta, 111 (9), 665-670
151. M. Redshaw, R. Bhandari, N. Gamage, M. Hasan, M. H. Gamage, D. K. Keblbeck, S. Limarenko, D. Perera. 2023. Status of CHIP-TRAP: The Central Michigan University High-Precision Penning Trap, Atoms, 11 (10), 127 <https://doi.org/10.3390/atoms11100127>

Internal report

152. M. M. Hasan, M. S. Uddin, A. K. M. Shafiq Ullah, M. Hasan and M. A. Shariff. "Experimental and Theoretical Studies on Deuteron Induced Reactions on Natural Iron: Production of ^{51}Cr and $^{52,54}\text{Mn}$ ". Atomic Energy Research Establishment Technical Report, ISSN 2074-2371, AERE/TR-29, 2023 (submitted).
153. M. Hasan, M. M. Hasan, M. S. Uddin, A. K. M. Shafiq Ullah, F. Ahmed, M. L. Akhter, A. Hossain and M. A. Shariff. "Adjustment of the Radio Frequency Driver of the 3MV Tandem Accelerator Facility". Atomic Energy Research Establishment Technical Report, ISSN 2074-2371, AERE/TR-29, 2023 (Submitted).

Isotope Hydrology Division, INST

154. Hassan, H. B., Moniruzzaman, M., Majumder, R. K., Ahmed, F., Bhuiyan, M. a. Q., Ahsan, M. A., & Al-Asad, H. 2023. Impacts of seasonal variations and wastewater discharge on river quality and associated human health risks: A case of northwest Dhaka, Bangladesh. Heliyon, 9(7), e18171. <https://doi.org/10.1016/j.heliyon.2023.e18171>
155. Asad, H. A., Moniruzzaman, M., Sarker, A. K., Bhuiyan, M. a. Q., & Ahsan, M. A. 2023. Hydrogeochemical evaluation, groundwater contamination and associated health risk in southern Tangail, Bangladesh. Chemosphere, 332, 138806. <https://doi.org/10.1016/j.chemosphere.2023.138806>

Internal Reports

156. D. Chowdhury, R. Amin, M. M. Rahman, M. A. Hossain, M. F. Waheed, R. Akhter, M. S. Reza, F. T. Jahura, M. Ashaduzzaman, S. B. Amin, R. C. Acharjee, A. S. Sikder and K. K. Hossain. "Bulk Iodine (^{131}I) Dispensing and Supply from RIPD Division in 2022", AERE/TR-28, 2023.
157. R. Amin, D. Chowdhury, M. M. Rahman, M. A. Hossain, M. F. Waheed, R. Akhter, M. S. Reza, F. T. Jahura, M. Ashaduzzaman, S. B. Amin, R. C. Acharjee, A. S. Sikder and K.K. Hossai. "Production of $^{99}\text{Mo}/^{99\text{m}}\text{Tc}$ Chromatographic Generator at Radioisotope Production Division in 2022", AERE/TR-28, 2023.

INSTITUTE OF ELECTRONICS (IE), AERE

General Electronics Division, IE

International Publication

158. Md. Ziaul Hasan Majumder, Mosa. Tania Alim Shampa, Md. Ariful Islam, Shamim Ahmed Deowan, Farhana Hafiz. 2024. Marine renewable energy harnessing for sustainable development in Bangladesh: A technological review, *Journal of Energy Reports*, Vol. 11, <https://doi.org/10.1016/j.egy.2024.01.001>.
159. Md Ariful Islam, Md Ziaul Hasan Majumder, Md Sohel Miah, Sumaia Jannaty. 2024. Precision healthcare: A deep dive into machine learning algorithms and feature selection strategies for accurate heart disease prediction, *Journal of Computers in Biology and Medicine*, <https://doi.org/10.1016/j.compbimed.2024.108432>.
160. Md Ariful Islam, Md Ziaul Hasan Majumder, Md Alomgeer Hussein, Khondoker Murad Hossain, Md Sohel Miah. 2024. A review of machine learning and deep learning algorithms for Parkinson's disease detection using handwriting and voice datasets, *Journal of Heliyon*, Elsevier, <https://doi.org/10.1016/j.heliyon.2024.e25469>.
161. Subrata Saha, Md Shamimul Islam, Md Mahbub Alam, Md Motinur Rahman, Md Ziaul Hasan Majumder, Md Shah Alam, M Khalid Hossain. 2023. Bengali Cyberbullying Detection in Social Media Using Machine Learning Algorithms, 5th International Conference on Sustainable Technologies for Industry 5.0 (STI), IEEE, doi: 10.1109/STI59863.2023.10464740.

Solar Cell Fabrication and Research Division, IE**International**

162. S. M. A. A. Zumahi, M. K. Basher, N. Arobi, M. M. Rahman, A. M. Tawfeek, M. A. R. Akand, M. M. Rahman, M. Nur-E-Alam, and M. K. Hossain. 2024. High-efficiency silicon solar cells designed on experimentally achieved nano-engineered low-reflective silicon surface, *Journal of Optics*, pp. 1-15 .
163. M. K. Basher, S. M. S. Riyadh, M. K. Hossain, M. Hassan, M. A. R. Akand, S. M. A. A. Zumahi, M. A. Matin, N. Das, and M. Nur-E-Alam. 2023. Development of zinc-oxide nanorods on chemically etched zinc plates suitable for high-efficiency photovoltaics solar cells, *Optical and Quantum Electronics*, 55 (4), , pp. 322.
164. M. N. Islam, M. S. Alam, S. Sultana, H. Akhter and M. A. S. Haque. 2023. Design and Development of a PIC Microcontroller Based High Voltage Power Supply, *Int. J. of Trend in Sci. Res. and Development (IJTSRD)*, e-ISSN: 2456 - 6470, Impact Factor: 8.125, Vol.7 (6), pp.624-628.

Robotics Instrumentation and Control Division, IE**International**

165. M.K. Hossain, *et al.*, 2023. Design Insights into $\text{La}_2\text{NiMnO}_6$ -Based Perovskite Solar Cells Employing Different Charge Transport Layers: DFT and SCAPS-1D Frameworks, *Energy & Fuels*. 37 (2023) 13377.
166. M.K. Hossain, *et al.*, 2023. Pandey, High-Efficiency Lead-Free $\text{La}_2\text{NiMnO}_6$ -Based Double Perovskite Solar Cell by Incorporating Charge Transport Layers Composed of WS_2 , ZnO , and $\text{Cu}_2\text{FeSnS}_4$, *Energy & Fuels*. 37 (2023) 19898.
167. M.K. Hossain, *et al.*, 2023. Harnessing the potential of CsPbBr_3 -based perovskite solar cells using efficient charge transport materials and global optimization, *RSC Adv.* 13 (2023) 21044.
168. M.K. Hossain, *et al.*, 2024. An extensive study on charge transport layers to design and optimization of high-efficiency lead-free Cs_2Ptl_6 -based double-perovskite solar cells: A numerical simulation approach, *Results Phys.* 61 (2024) 107751.
169. M.K. Hossain, *et al.*, 2023. Optimization of the architecture of lead-free CsSnCl_3 -perovskite solar cells for enhancement of efficiency: A combination of SCAPS-1D and wxAMPS study, *Mater. Chem. Phys.* 308 (2023) 128281.
170. M.K. Hossain, *et al.*, 2023. Achieving above 24% efficiency with non-toxic CsSnI_3 perovskite solar cells by harnessing the potential of the absorber and charge transport layers, *RSC Adv.* 13 (2023) 23514.
171. M.K. Hossain, *et al.*, 2023. An extensive study on multiple ETL and HTL layers to design and simulation of high-performance lead-free CsSnCl_3 -based perovskite solar cells, *Sci. Rep.* 13 (2023) 2521.

172. M.S. Uddin, M.K. Hossain, *et al.*, 2024. An In-Depth Investigation of the Combined Optoelectronic and Photovoltaic Properties of Lead-Free $\text{Cs}_2\text{AgBiBr}_6$ Double Perovskite Solar Cells Using DFT and SCAPS-1D Frameworks, *Adv. Electron. Mater.* 10 (2024).
173. G.F.I. Toki, M.K. Hossain, *et al.*, 2024. Optimizing lead-free $\text{Cs}_3\text{Bi}_2\text{I}_9$ perovskite solar cells: exploring absorber and charge transport layers parameters for improved efficiency, *J. Opt.* (2024).
174. G.F.I. Toki, M.K. Hossain, *et al.*, 2024. Unveiling the potential of lead-free $\text{Cs}_2\text{AgBi}_{0.75}\text{Sb}_{0.25}\text{Br}_6$ double perovskite solar cells with multilayer charge transport for 30% efficiency, *Inorg. Chem. Commun.* 165 (2024) 112439.
175. S. Bhattarai, M.K. Hossain, *et al.*, 2023. Performance enhancement using an embedded nano-pyramid in a perovskite solar cell with TaTm as a hole transport layer, *New J. Chem.* 47 (2023) 18332.
176. S. Bhattarai, M.K. Hossain, *et al.*, 2023. Performance improvement of CZTS-based hybrid solar cell with double hole transport layer using extensive simulation, *J. Phys. Chem. Solids.* 183 (2023) 111641.
177. S. Bhattarai, M.K. Hossain, *et al.*, 2023. Efficiency enhancement of perovskite solar cell devices utilizing MXene and TiO_2 as an electron transport layer, *New J. Chem.* 47 (2023) 17908.
178. S. Bhattarai, M.K. Hossain, *et al.*, 2023. Comparative Study of Distinct Halide Composites for Highly Efficient Cesium-Based Perovskite Solar Cells, *Energy & Fuels.* 37 (2023) 16035.
179. S. Bhattarai, M.K. Hossain, *et al.*, 2023. Perovskite Solar Cells with Dual Light Absorber Layers for Performance Efficiency Exceeding 30%, *Energy & Fuels.* 37 (2023) 10631.
180. S. Bhattarai, M.K. Hossain, *et al.*, 2024. Performance improvement of HTL-free perovskite solar cells with the graded approach by numerical simulation, *J. Phys. Chem. Solids.* 184 (2024).
181. S. Bhattarai, M.K. Hossain, *et al.*, 2024. Enhancement of efficiency in CsSnI_3 based perovskite solar cell by numerical modeling of graphene oxide as HTL and ZnMgO as ETL, *Heliyon.* 10 (2024) e24107.
182. K.T. ArockiyaDass, M.K. Hossain, L. Marasamy, 2024. Highly efficient emerging $\text{Ag}_2\text{BaTiSe}_4$ solar cells using a new class of alkaline earth metal-based chalcogenide buffers alternative to CdS , *Sci. Rep.* 14 (2024) 1473.
183. S. Bhattarai, R. Pandey, J. Madan, M.Z. Ansari, M.K. Hossain, *et al.*, 2024. Chlorine-doped perovskite materials for highly efficient perovskite solar cell design offering an efficiency of nearly 29%, *Prog. Photovoltaics Res. Appl.* 32 (2024) 25.
184. P. Chauhan, S. Agarwal, V. Srivastava, S. Maurya, M.K. Hossain, *et al.*, 2024. Impact on generation and recombination rate in $\text{Cu}_2\text{ZnSnS}_4$ (CZTS) solar cell for Ag_2S and In_2Se_3 buffer layers with CuSbS_2 back surface field layer, *Prog. Photovoltaics Res. Appl.* 32 (2024) 156.
185. D. Gogoi, M.K. Hossain, T.D. Das. 2024. Investigation of excellent transparent conducting electrode for efficient organometallic halide perovskite solar cell, *Indian J. Phys.* (2024).
186. D. Gogoi, M.K. Hossain, *et al.* 2024. Performance analysis of highly efficient lead-free perovskite solar cells: a numerical insight, *J. Opt.* (2024).
187. D. Pal, S. Das, M.K. Hossain, *et al.* 2024. A numerical approach to optimize the efficiency of a novel HTL-free $\text{Sr}_3\text{Ti}_2\text{S}_7$ Ruddlesden-Popper perovskite solar cell, *Inorg. Chem. Commun.* 165 (2024) 112529.
188. K. Bhavani, J. Christina Rhoda, M.K. Hossain, C. Karnan. 2024. Growth, spectral, optical, and third harmonic generation studies of p-Hydroxyacetanilide (PHA) crystals, *Opt. Mater. (Amst).* 148 (2024) 114924.
189. B.K. Ravidas, A. Das, S.K. Agnihotri, R. Pandey, J. Madan, M.K. Hossain, *et al.* 2024. Design principles of crystalline silicon/ CsGeI_3 perovskite tandem solar cells using a combination of density functional theory and SCAPS-1D frameworks, *Sol. Energy Mater. Sol. Cells.* 267 (2024) 112688.
190. Dixit, D.P. Samajdar, R.P. Shukla, N. Bagga, M.K. Hossain. 2024. Biomolecule detection using $\text{GaAs}_{1-x}\text{Sb}_x$ FET based dielectric modulated label-free biosensor, *Phys. Scr.* 99 (2024) 025020.
191. M.E. Emetere, A.W. Omotoso, S.A. Afolalu, L. Amusan, T.C. Jen, M.K. Hossain. 2024. Naturally Occurring Radioactive Materials and Heavy Metals in Photovoltaics: Insights into Short- and Long-Term Waste Hazards, *J. Hazardous, Toxic, Radioact. Waste.* 28 (2024).

192. A.A. Feshchanka, V.V. Khoroshko, M.V. Tumilovich, M.I. Sayyed, M.K. Hossain, *et al.* 2024. Growth and characterization of thermal properties of single crystals of solid solutions $Mn_xFe_{1-x}In_2S_4$, *J. Cryst. Growth.* 640 (2024) 127763.
193. K.M. Hossain, M.H.K. Rubel, M.K. Hossain, *et al.* 2024. Hydrothermal Synthesis, Phase Analysis, and Magneto-Electronic Characterizations of Lead-Free Ferroelectric BM^{2+} (Zn, Ca, Mg)T–BFO System, *ACS Omega.* 9 (2024) 9147.
194. M.M. Hussein, S.A. Saafan, H.F. Abosheisha, S.V. Trukhanov, M.K. Hossain, *et al.* 2024. Co-Ni spinel nanoparticles for energy storage applications: Composition, structural parameters and electrical properties, *Nano-Structures & Nano-Objects.* 38 (2024) 101181.
195. M. Chitkara, N. Goyal, A. Kumar, L. Marasamy, S. Haq, S.A. Aldossari, R. Haldhar, M.K. Hossain. 2024. Tailoring graphene-oxide and reduced-graphene-oxide with $NaNO_3$ and $CaCl_2$ catalysts with enhanced photo-catalytic degradation of methylene blue dye, *RSC Adv.* 14 (2024) 8769.
196. D. Dastan, M.K.A. Mohammed, R. Sh. Alnayli, S. M. Majeed, D.S. Ahmed, A.K. Al-Mousoi, R. Pandey, M.K. Hossain, *et al.* 2024. Achieving Well-Oriented $FAPbI_3$ Perovskite Photovoltaics by Cyclohexane Modification, *Langmuir.* 40 (2024) 7560.
197. S. Ghotekar, P. Basnet, H.E.A. Mohamed, K.-Y.A. Lin, A. Rahdar, M.K. Hossain, *et al.* 2024. A novel approach towards biosynthesis of $BiVO_4$ nanoparticles and their anticancer, antioxidant, and photocatalytic activities, *J. Sol-Gel Sci. Technol.* 109 (2024) 784.
198. L. Marasamy, A.-D. RasuChettiar, R. Manisekaran, E. Linda, M.F. Rahman, M.K. Hossain, *et al.* 2024. Impact of selenization with NaCl treatment on the physical properties and solar cell performance of crack-free $Cu(In,Ga)Se_2$ microcrystal absorbers, *RSC Adv.* 14 (2024) 4436.
199. R. Jansi, B. Vinay, M.S. Revathy, P. Sasikumar, L. Marasamy, A. Janani, R. Haldhar, S.-C. Kim, Z.M. Almarhoon, M.K. Hossain. 2024. Synergistic Blends of Sodium Alginate and Pectin Biopolymer Hosts as Conducting Electrolytes for Electrochemical Applications, *ACS Omega.* 9 (2024) 13906.
200. M.H. Kabir, M.Z. Hossain, M.A. Jalil, S. Ghosh, M.M. Hossain, M.A. Ali, M.U. Khandaker, D. Jana, M.M. Rahman, M.K. Hossain, *et al.* 2024. The efficacy of rare-earth doped V_2O_5 photocatalyst for removal of pollutants from industrial wastewater, *Opt. Mater. (Amst).* 147 (2024) 114724.
201. H.G. Mohamed, A. Nour, A.I. Abd-Elhamid, M.S. Gohr, H. El-Gendi, R.H. El-Sayed, A.A. El-Bardan, M.K. Hossain, *et al.* 2024. Enhancement of methylene blue catalytic reduction by novel green synthesized metal decorated reduced graphene oxide: $Sn@rGO$ and $Ag@rGO$, *J. Alloys Compd.* 997 (2024) 174920.
202. M.K.A. Mohammed, A.K. Al-Mousoi, A. Kumar, M.M. Sabugaa, R. Seemaladinne, R. Pandey, J. Madan, M.K. Hossain, *et al.* 2023. Harnessing the potential of Dion-Jacobson perovskite solar cells: Insights from SCAPS simulation techniques, *J. Alloys Compd.* 963 (2023) 171246.
203. M.A. Rahman, Z. Hasan, H.K. Rouf, M.K. Alam, A.K.M.A. Hossain, M.N.I. Khan, M.R. Mohammad, A. Alodhayb, S. Mohammad, R. Haldhar, M.K. Hossain. 2024. Study on the magnetoelectric effect, ferroelectric and optical investigation of $(1-x)BCT+xNZLFO$ multiferroic composite, *Int. J. Appl. Ceram. Technol.* (2024).
204. M.M. Rahman, M.I. Howlader, A.Z.M. Mofasser, N.I. Sayed, I.B. Shuva, R. Mia, M.A. Habila, M.K. Hossain, Z. Shen. 2024. Colour dynamics and compatibility: A comparative analysis of reactive dyes on ramie and cotton fabrics, *J. Eng. Fiber. Fabr.* 19 (2024).
205. B. Sharker, M.A. Islam, M.A.A. Hossain, I. Ahmad, A. Al Mamun, S. Ghosh, A. Rahman, M.S. Hossain, M.A. Ashik, M.R. Hoque, M.K. Hossain, *et al.* 2023. Characterization of lignin and hemicellulose degrading bacteria isolated from cow rumen and forest soil: Unveiling a novel enzymatic model for rice straw deconstruction, *Sci. Total Environ.* 904 (2023) 166704.
206. G.F.I. Toki, M.N. Sharif, M.A. Hossen, A. Rahman, R. Mia, M.R. Repon, M.S. Sk, T.M. Almutairi, M.K. Hossain. 2024. Sustainable coloration and analysis of cellulosic viscose fabric incorporating Rosa rubiginosa extraction and pre-mordanting approaches, *Mater. Today Commun.* 38 (2024) 108068.

207. M. Zain, K.A. Yasin, S. Haq, W. Rehman, S.U. Din, S. Shujaat, A. Syed, M.K. Hossain, *et al.* 2024. Effect of calcination temperature induced structural modifications on the photocatalytic efficacy of $\text{Fe}_2\text{O}_3\text{-ZrO}_2$ nanostructures: mechanochemical synthesis, *RSC Adv.* 14 (2024) 15085.
208. Sanyal Dipto, L. Mondal, J. Hossain, M.M. Rashid, M.K. Hossain, *et al.* 2023. Synthesis of Transparent CuI Thin Films by a Facile Low-Cost High Pressure (HP)-PECVD Method at Room Temperature for the Application in Solar Cells, *ChemistryOpen.* 12 (2023).
209. E. Bharathi, C. Rajeevgandhi, M. Abbas, K. Selvakumar, P. Sasikumar, L. Gunganathan, S. Senthilvelan, M.K. Hossain. 2024. Application of natural solar photocatalytic and DSSC's studies AC loaded on Ag-In $_2\text{O}_3$ nanoparticles by hydrothermal approach, *Heliyon.* 10 (2024) e26866.
210. Ghosh, M.F. Rahman, M.R. Islam, M.S. Islam, M.K. Hossain, *et al.* 2023. Structural, electronic and optical characteristics of inorganic cubic perovskite Sr_3AsI_3 , *Opt. Contin.* 2 (2023) 2144.
211. D.P. Tripathi, S. Agarwal, D.K. Dwivedi, P. Lohia, R.K. Yadav, M.K. Hossain. 2024. Physical properties and thermal stability of the $\text{GeTe}_{2-x}(\text{SeSb})_x$ ($x = 0, 0.2, 0.4, 0.6$) chalcogenide glasses, *Pramana.* 98 (2024) 61.
212. S. Bhattarai, D. Jayan K, R. Pandey, J. Madan, M.Z. Ansari, M. Amami, M.K. Hossain. 2023. Optimized High-Efficiency Solar Cells with Dual Hybrid Halide Perovskite Absorber Layers, *Energy & Fuels.* 37 (2023) 16022.
213. N. Kaur, R. Pandey, M.K. Hossain, J. Madan. 2023. Machine learning-aided optimization for transport layer parameters of low lead inorganic Zn-based mixed-halide perovskite solar cell, *Sol. Energy.* 264 (2023) 112055.
214. S. Agarwal, D.K. Dwivedi, P. Lohia, S.K. Sharma, M.A. Habila, M.K. Hossain. 2024. Phenomenology of M-N rule and high-field conduction in Ge-Te-Se-Sc rare-earth doped glasses, *J. Mater. Sci. Mater. Electron.* 35 (2024) 382.
215. Ghosh, M.F. Rahman, M.R. Islam, M.S. Islam, M. Amami, M.K. Hossain, A.B. Md Ismail. 2023. Inorganic novel cubic halide perovskite Sr_3AsI_3 : Strain-activated electronic and optical properties, *Heliyon.* 9 (2023) e19271.
216. Z. Younsi, F. Meddour, H. Bencherif, M.K. Hossain, *et al.* 2024. Scrutinizing transport phenomena and recombination mechanisms in thin film Sb_2S_3 solar cells, *Sci. Rep.* 14 (2024) 12460
217. P. Lohia, S. Singh, V. Srivastava, S. Agarwal, D.K. Dwivedi, S. Rai, A.M. Tighezza, M.K. Hossain. 2024. Performance enhancement of organic perovskite solar cell with graphene oxide as electron transport layer, *J. Opt.* (2024).
218. S. Rabhi, T.A. Hameed, S. Mayarambakam, M.K. Hossain, K. Sekar. 2024. The impact of CBz-PAI interlayer in various HTL-based flexible perovskite solar cells: A drift-diffusion numerical study, *Heliyon.* 10 (2024) e31138.
219. P. Chauhan, S. Agarwal, V. Srivastava, Sadanand, M.K. Hossain, *et al.* 2023. Kesterite CZTS based thin film solar cell: Generation, recombination, and performance analysis, *J. Phys. Chem. Solids.* 183 (2023) 111631.
220. N. Shrivastav, V. Yadav, S. Bhattarai, J. Madan, M.K. Hossain, *et al.* 2023. Two-terminal tandem solar cell with $\text{Sb}_2\text{S}_3/\text{Sb}_2\text{Se}_3$ absorber pair: achieving 14% power conversion efficiency, *Phys. Scr.* 98 (2023) 115110.
221. M.F. Rahman, M.H. Rahman, M.R. Islam, M.K. Hossain, *et al.* 2023. The optical and electronic properties of inorganic halide perovskite Sr_3NCl_3 under applied biaxial strain, *J. Mater. Sci.* 58 (2023) 13100.
222. Hajjiah, A. Hajjiah, M.K. Hossain, N.E. Gorji. 2023. Modeling the impact of grain size on device characteristics of Sb_2Se_3 solar cells, *Mater. Sci. Eng. B.* 303 (2024) 117319.
223. P. Pandey, S. Yadav, D.K. Dwivedi, P. Lohia, A.C. Mishra, R.K. Yadav, M.K. Hossain, *et al.* 2024. Performance analysis of highly sensitive PCF sensor for drug detection, *J. Opt.* (2024).

224. N. Shrivastav, J. Madan, M.K. Hossain, *et al.* 2024. Investigating inorganic perovskite as absorber materials in perovskite solar cells: machine learning analysis and optimization, *Phys. Scr.* 99 (2024) 035536.
225. N. Shrivastav, J. Madan, M.K. Hossain, *et al.* 2024. Design and simulation of three-junction all perovskite tandem solar cells: A path to enhanced photovoltaic performance, *Mater. Lett.* 362 (2024) 136169.
226. N.P. Singh, A.C. Mishra, S. Yadav, P. Lohia, D.K. Dwivedi, M.K. Hossain. 2024. Highly Sensitive SPR Biosensor for Malaria Detection Employing ZnO, Fe₂O₃, and Black Phosphorous, *Plasmonics*. (2024).
227. S. Singh, S.K. Agnihotri, V.K. Tewari, K.K. Bharti, M.K. Hossain, D.P. Samajdar. 2024. Insights into the design principles of JF-ED-VTFET for biosensing application, *Phys. Scr.* 99 (2024) 045012.
228. F.B. Sumona, M. Kashif, E. Danladi, A.M. Tighezza, N. Al-Mahmud, G.F.I. Toki, R. Pandey, M.K. Hossain. 2023. Optimization of Perovskite-KSnI₃ Solar Cell by Using Different Hole and Electron Transport Layers: A Numerical SCAPS-1D Simulation, *Energy & Fuels*. 37 (2023) 19207.
229. M.S. Uddin, M.A. Al Mashud, G.F.I. Toki, R. Pandey, M. Zulfiqar, O. Saidani, K. Chandran, M. Ouladsmane, M.K. Hossain. 2023. Lead-free Ge-based perovskite solar cell incorporating TiO₂ and Cu₂O charge transport layers harnessing over 25% efficiency, *J. Opt.* (2023).
230. N. Shrivastav, S. Kashyap, J. Madan, A.K. Al-Mousoi, M.K.A. Mohammed, M.K. Hossain, *et al.* 2023. Perovskite-CIGS Monolithic Tandem Solar Cells with 29.7% Efficiency: A Numerical Study, *Energy & Fuels*. 37 (2023) 3083.
231. W. Henni, W.L. Rahal, G.F.I. Toki, M.K.A. Mohammed, L. Ben Farhat, S. Ezzine, R. Pandey, A. Boukortt, M.K. Hossain. 2023. Effect of Adding Cu₂O as a Back Surface Field Layer on the Performance of Copper Manganese Tin Sulfide Solar Cells, *Sustainability*. 15 (2023) 14322.
232. M.S. Reza, M.F. Rahman, A. Kuddus, M.K.A. Mohammed, A.K. Al-Mousoi, M.R. Islam, A. Ghosh, S. Bhattarai, R. Pandey, J. Madan, M.K. Hossain. 2023. Boosting efficiency above 28% using effective charge transport layer with Sr 3 Sbl 3 based novel inorganic perovskite, *RSC Adv.* 13 (2023) 31330.
233. Y. Singh, D.K. Dwivedi, P. Lohia, A.C. Mishra, S. Yadav, G.E. Eldesoky, M.K. Hossain. 2024. Highly Sensitive Plasmonic Biosensor for the Detection of Chikungunya Virus Employing TiO₂ and BP/WS₂Heterostructure, *Plasmonics*. (2024).
234. S. Chaurasia, P. Lohia, D.K. Dwivedi, R. Pandey, J. Madan, S. Yadav, Y.K. Singh, N.H. Alotaibi, M.K. Hossain. 2024. Highly efficient and stable Dion–Jacobson(DJ) 2D-3D perovskite solar cells with 26 % conversion efficiency: A SCAPS-1D study, *J. Phys. Chem. Solids*. 191 (2024) 112038.
235. Y.S. Itas, N.H. Alotaibi, S. Mohammad, R. Haldhar, S.-C. Kim, M.K. Hossain. 2024. DFT studies on structural, electronic and optical properties of aluminum nitride nanotube doped by different concentrations of boron, *Mater. Chem. Phys.* 320 (2024) 129429.
236. S. Malhotra, L. Gupta, H. Nandan, M.K.A. Mohammed, M.K. Hossain, *et al.* 2024. Tailoring the Hole Transport Layer and Understanding the Impact of Sn Oxidation for Different Mixed Halide Perovskite Active Layers: On a Quest for the Perfect Match, *Energy & Fuels*. 38 (2024) 3417.
237. S. Bhattarai, D. Borah, J. Rout, R. Pandey, J. Madan, I. Hossain, P. Handique, M.Z. Ansari, M.K. Hossain, M.F. Rahman. 2023. Designing an efficient lead-free perovskite solar cell with green-synthesized CuCrO₂ and CeO₂ as carrier transport materials, *RSC Adv.* 13 (2023) 34693–34702.
238. S. Bhattarai, D. Jayan, A. Yousfi, M. Chowdhury, M.F. Rahman, R. Pandey, J. Madan, M.Z. Ansari, M.K. Hossain. 2023. Novel double graded perovskite materials for performance increment of perovskite solar cell using extensive numerical analysis, *Phys. Scr.* 98 (2023) 095507.
239. S. Bhattarai, J. Madan, R. Pandey, D.P. Samajdar, D. Muchahary, M. Amami, S. Ezzine, M.K. Hossain. 2023. Performance Improvement of Hybrid-Perovskite Solar Cells with Double Active Layer Design Using Extensive Simulation, *Energy & Fuels*. 37 (2023) 16893–16903.

240. S. Bhattarai, M.K.A. Mohammed, J. Madan, R. Pandey, H. Abdelkader, L. Ben Farhat, M. Amami, M.K. Hossain. 2023. Comparative Study of Different Perovskite Active Layers for Attaining Higher Efficiency Solar Cells: Numerical Simulation Approach, *Sustainability*. 15 (2023) 12805.
241. S. Bhattarai, M.K.A. Mohammed, J. Madan, R. Pandey, M.Z. Ansari, A.N. ZakiRashed, M. Amami, M.K. Hossain. 2023. Performance Improvement of Perovskite Solar Cell Design with Double Active Layer to Achieve an Efficiency of over 31%, *Sustainability*. 15 (2023) 13955.
242. S. Bhattarai, R. Pandey, J. Madan, S. Tayeng, P.K. Kalita, M.Z. Ansari, L. Ben Farhat, M. Amami, M.K. Hossain. 2024. Comparative study of distinct halide composites for highly efficient perovskite solar cells using a SCAPS-1D simulator, *RSC Adv.* 13 (2023) 26851–26860.
243. S. Bhattarai, G.F.I. Toki, J. Madan, M. Amami, R. Pandey, D.P. Samajdar, S. Ezzine, M.Z. Ansari, M.K. Hossain. 2023. Design Principles of a Novel Triple Perovskite Absorber for Efficiency Enhancement: An Optimization Study, *Energy & Fuels*. 37 (2023) 19845.
244. N. Kaur, J. Madan, M.K.A. Mohammed, D.P. Samajdar, M.K. Hossain, R. Pandey. 2023. Low lead inorganic Zn-based mixed-halide perovskites $\text{CsPb}_{0.625}\text{Zn}_{0.375}\text{I}_{3-\beta}\text{X}_{\beta}$ ($\text{X} = \text{Cl}$ or Br) for energy generation with 23.5% efficiency, *Phys. Scr.* 98 (2023) 115941.
245. J. Singh, S. Agarwal, V. Srivastava, M. Sadanand, M.K. Hossain, *et al.* 2023. Attaining above 30% efficiency of PbS-based colloidal quantum dot solar cell using MoO_3 and SnO_2 as charge transport layers: a numerical approach, *J. Opt.* (2023).
246. N. Shrivastav, J. Madan, M.K.A. Mohammed, M.K. Hossain, R. Pandey. 2024. CsPbI_3 - perovskite quantum dot solar cells: unlocking their potential through improved absorber layer characteristics and reduced defects, *Mater. Res. Express*. 10 (2023) 075506.
247. N. Shrivastav, J. Madan, M.K.A. Mohammed, A.K. Al-Mousoi, M.K. Hossain, *et al.* 2024. Optimizing the performance of $\text{Cs}_2\text{AgBiBr}_6$ based solar cell through modification of electron and hole transport layers, *Mater. Today Commun.* 36 (2023) 106761.
248. Y.K. Singh, D.K. Dwivedi, P. Lohia, R. Pandey, J. Madan, M.K. Hossain, *et al.* 2024. Filtered spectrum modeling of high-performance perovskite tandem solar cells: Tailoring absorber properties and electron/hole transport layers for 31.55 % efficiency, *J. Phys. Chem. Solids*. 192 (2024) 112096.
249. Singh, V. Srivastava, S. Singh, Sadanand, S. Rai, P. Lohia, D.K. Dwivedi, S. Agarwal, M. Ouladsmene, M.K. Hossain. 2024. Optimization of highly efficient inorganic lead-free double perovskite solar cells via SCAPS-1D, *J. Opt.* 53 (2024) 2405.
250. M.R. Islam, A. Zahid, M.A. Rahman, M.F. Rahman, M.A. Islam, M.K. Hossain, *et al.* 2024. Tuning the optical, electronic, and mechanical properties of inorganic Ca_3PbI_3 perovskite via biaxial strain, *J. Phys. Chem. Solids*. 184 (2024).
251. M.S. Islam, M.F. Rahman, M.R. Islam, A. Ghosh, M.A. Monnaf, M.S. Reza, M.K. Hossain, *et al.* 2024. An in-depth analysis of how strain impacts the electronic, optical, and output performance of the Ca_3NI_3 novel inorganic halide perovskite, *J. Phys. Chem. Solids*. 185 (2024) 111791.
252. S.M.A.-A. Zumahi, M.K. Basher, N. Arobi, M.M. Rahman, A.M. Tawfeek, M.A.R. Akand, M.M. Rahman, M. Nur-E-Alam, M.K. Hossain. 2024. High-efficiency silicon solar cells designed on experimentally achieved nano-engineered low-reflective silicon surface, *J. Opt.* (2024).
253. P. Barman, M.F. Rahman, M.R. Islam, M. Hasan, M. Chowdhury, M.K. Hossain, *et al.* 2023. Lead-free novel perovskite Ba_3AsI_3 : First-principles insights into its electrical, optical, and mechanical properties, *Heliyon*. 9 (2023) e21675.
254. F. Kherrat, L. Dehimi, H. Bencherif, M.M.A. Moon, M.K. Hossain, *et al.* 2023. Performance enhancement of eco-friendly $\text{Cs}_3\text{Sb}_2\text{I}_9$ -based perovskite solar cell employing Nb_2O_5 and CuI as efficient charge transport layers, *Micro and Nanostructures*. 183 (2023) 207676.
255. M.K.A. Mohammed, S.M. Abdalhadi, A. Kumar, O.P. Doshi, A.K. Al-Mousoi, H.T. Hussein, R.S. Alnayli, J. Madan, A.M. Tawfeek, M.F. Rahman, M.K. Hossain. 2023. Designing a Novel Hole-Transporting Layer for FAPbI_3 -Based Perovskite Solar Cells, *Energy & Fuels*. 37 (2023) 19870.

256. M.K.A. Mohammed, A.K. Al-Mousoi, A. Kumar, A.R.J. Katae, O.A. Khaleel, D.S. Ahmed, M.K. Hossain. 2023. Fluorinated carbon nanotubes: a low-cost hole transport layer for perovskite solar cells, *J. Mater. Sci.* 58 (2023) 11748.
257. M.F. Rahman, M. Harun-Or-Rashid, M.R. Islam, A. Ghosh, M.K. Hossain, *et al.* 2023. Exploring the impact of strain on the electronic and optical properties of inorganic novel cubic perovskite Sr_3Pb_3 , *Phys. Scr.* 98 (2023) 115105.

Very Large Scale Integration (VLSI) Technology Division, IE

International

258. Das, P., Sen, S.K., Manir, M.S. A. A. Mortuza et al. 2024. Impact of TiO_2 Nanoparticles on Seed Germination and Growth of Nonabokra Rice, Mortality of Bean Weevil, and Antibacterial and Cytotoxic Activity, *BioNanoSci.* 14, 102–118 (2024). <https://doi.org/10.1007/s12668-023-01273-0>

INSTITUTE OF COMPUTER SCIENCE (ICS), AERE

Computer System And Network Division, ICS

International

259. Haidar Ali, Mohammad Zonaid Bin Ferdous, Imran Hossain Showrov, Osman Goni, Mahbub Alam and Abu Shameem. 2023. Cyber Security: Challenges, Threats and Protective Measures of an Organization Published on I.J. of Electronics and Information Engineering, Vol.15, No.1, PP.1-11, Dec. 2023 (DOI: 10.6636/IJEIE.202312 15(1).01),
260. Islam, Md Shamimul, Nayan Kumar Datta, Md Imran Hossain Showrov, Md Mahbub Alam, Md Haidar Ali, and Md Dulal Hossain. 2023. Organizational Network Monitoring and Security Evaluation Using Next-Generation Firewall (NGFW), In *The Fourth Industrial Revolution and Beyond: Select Proceedings of IC4IR+*, pp. 133-147. Singapore: Springer Nature Singapore, 2023.
261. Md. Haidar Ali, Showrov, Md. Mahbub Alam, Md. Abu Shameem, Osman Goni. The Basic Concept of Cyber Crime, published by the Journal of Technology Innovations and Energy

Software Engineering Division, ICS

International

262. Md. Shamimul Islam, Nayan Kumar Datta, Md Mahbub Alam et Al. 2023. *Organizational Network Monitoring and Security Evaluation using Next Generation Firewall (NGFW)*, The 4th Industrial Revolution and Beyond (IC4IR), Lecture Notes in Electrical Engineering, Springer Nature Singapore Pte Ltd.2023, Vol. 980, PP.133-147, https://doi.org/10.1007/978-981-19-8032-9_10
263. Md. Shamimul Islam, Nayan Kumar Datta, Md Mahbub Alam et Al. 2023. *Natural Language Processing and Machine Learning Approaches to Detect Bangla Hate Speech on Social Media*”, 2023 26th International Conference on Computer and Information Technology (ICCIT), Cox's Bazar, Bangladesh, 2023, pp. 1-6, doi: 10.1109/ICCIT60459.2023.10441452.Publisher: IEEE

Nuclear Cyber Security, ICS

International

264. Islam, M.S., Uddin, M.A., Hossain, D.M.D., Ahmed, D.M.S. and Moazzam, D.M.G. 2023. Analysis and Evaluation of Network and Application Security Based on Next Generation Firewall. *International Journal of Computing and Digital Systems*, 13(1), pp.193-202.
265. Islam, M.S., Datta, N.K., Showrov, M.I.H., Alam, M.M., Ali, M.H. and Hossain, M.D. 2023. Organizational Network Monitoring and Security Evaluation Using Next-Generation Firewall (NGFW). In *The Fourth Industrial Revolution and Beyond: Select Proceedings of IC4IR+* (pp. 133-147). Singapore: Springer Nature Singapore.
266. Saha, S., Islam, M.S., Alam, M.M., Rahman, M.M., Majumder, M.Z.H., Alam, M.S. and Hossain, M.K. 2023, December. Bengali Cyberbullying Detection in Social Media Using Machine Learning Algorithms. In 2023 5th International Conference on Sustainable Technologies for Industry 5.0 (STI) (pp. 1-6). IEEE.

267. Islam, M.S., Saha, S., Alam, M.M., Datta, N.K., Ali, M.H., Hossain, M.D. and Moazzam, M.G. 2023. December. Natural Language Processing and Machine Learning Approaches to Detect Bangla Hate Speech on Social Media. In 2023 26th International Conference on Computer and Information Technology (ICCIT) (pp. 1-6). IEEE.

INSTITUTE OF ENERGY SCIENCES (IES), AERE

International

268. M.A. Khaer, M.A. Hoq, S.M.T. Hassan, M.T. Chowdhury, M.M. Rahman. 2023. Assessment of radiological dose and emergency planning zones of TRIGA Mark-II research reactor of Bangladesh due to a postulated severe accidental condition, Nucl. Eng. And Design, 415(2023), 112727
269. M.A. Khaer, M.A. Hoq, S.M.T. Hassan, M.T. Chowdhury, M.M. Rahman. 2024. An approach of radiological impact analysis due to a simulated accident of the TRIGA research reactor of Bangladesh, Radi. Phys. and Chem., 219(204), 111689
270. M.A. Hoq, M.A.M. Soner, S. Khanom, M.J. Uddin, M. Moniruzzaman, M.S.H. Chowdhury, A. Helal, M.A. Khaer, S.M.T. Hassan, M.T. Chowdhury, M.M. Rahman. 2024. Assessment of radiation dose associated with the atmospheric release of 41ar from the TRIGA Mark-II research reactor in Bangladesh, Sci. and Tech. of Nucl, Install., 2024, 9141535
271. S. Hossain, M.M. Parvez, A.M. Abdalla, M.T. Chowdhury, S.A. Lopa, I.B. Elius, C.D. Savaniu, J.H. Zaini, J.T.S. Irvine, A.K. Azad. 2023. Structure of Magnesium Doped Yttrium Barium Zirconate as a Novel Compound, Phys. Solid State, 65, 137-150
272. M.A. Zubair, T.K. Mouri, M.T. Chowdhury. 2023. Influence of Cu induced crystallographic disorder on the optical and lattice vibrational properties of ZnO nanoparticles, Phys. Chem. Chem. Phys., 2023, 25, 27628
273. M.U. Sumaya, K.H. Maria, F.T.Z. Toma, M.A. Zubair, M.T. Chowdhury. 2023. Effect of stabilizer content in different solvents on the synthesis of ZnO nanoparticles using the chemical precipitation method, Heliyon, 2023, 9, 10

Internal Report

274. M.A. Hoq, M.A. Khaer, S.M.T. Hassan, M.T. Chowdhury, M. M. Rahman. “Radiological Safety Assessment Due to 41Ar and 16N Airborne Release from the TRIGA Mark-II Research Reactor”. IES-33/NED-33, September 2023.
275. M.A. Khaer, M.A. Hoq, S.M.T. Hassan, M.T. Chowdhury, M. M. Rahman. “Assessment of Organ Committed Doses Due to a Hypothetical Accident of the BAEC TRIGA Mark-II Research Reactor”. IES-34/NED-34, September 2023.
276. M.A. Khaer, M.A. Hoq, S.M.T. Hassan, M.T. Chowdhury, M. M. Rahman. “Radiological Dose Assessment of Radio-cesium Using Gaussian Plume Model (GPM)”. IES-35/NED-35, September 2023.
277. M.A. Hoq, M.A. Khaer, S.M.T. Hassan, M.T. Chowdhury, M. M. Rahman. “Radiological Dose Assessment Using Gaussian Plume Model and Lagrangian Gaussian Plume Model”. IES-36/NED-36, September 2023.
278. M.A. Khaer, M.A. Hoq, S.M.T. Hassan, M.T. Chowdhury, M. M. Rahman. “Study of Radiological Doses Due to the Release of Noble Gas, Halogen, and Alkaline Group of Radionuclides Considering a Postulated Accident of TRIGA Mark-II Research Reactor”. IES-37/NED-37, September 2023.

INSTITUTE OF TISSUE BANKING AND BIOMATERIALS RESEARCH (ITBBR), AERE

International

279. Md. Rabiul Islam, Sapan Kumar Sen, Arup Kumar, M. S. Islam, M. S. Manir, Zannath Ara, M. D. Hossain, and M. K. Alam. 2024. Effect of gamma (γ -) irradiation on the structural, morphological, and optical properties of BaO nanoparticles green synthesized from *Moringa Oleifera* leaves. Heliyon, Volume 10, Issue 4, e26350.
280. Mohammed Hossan S Shohrawardy, Md Forhad Mina, AKM M Alam, Ruhul Amin Khan. 2024. Sunn hemp hessian cloth reinforced thermoplastic composites: effects of chemical treatment and

gamma-ray irradiation. *Journal of Thermoplastic Composite Materials*, 2024/7, volume-37, Issue-7, 2246-2269

281. Shahid Shohrawardy MH, Mina MF, Alam AM, Khan RA. 2024. The impact of chemical treatment and gamma-ray irradiation on the okra hessian cloth reinforced high-density polyethylene composites. *Journal of Elastomers & Plastics*. 2024;56(4):347-373
282. Sapan Kumar Sen, Md Shahadat Hossain, Ramesh Roy, M.S. Alam, Md Serajum Manir. 2024. Goshtha Gopal Biswas, Size-strain distribution analysis from XRD peak profile of (Mg, Fe) co-doped SnO₂ nanoparticles fabricated using chemical co-precipitation route, *Ceramics International*.
283. Sapan Kumar Sen, Mollika Paul, Md. Sakauat Hasan Sakib, Md. Serajum Manir, Karimul Hoque, Robi Sankar Hawlader, Md. Razibul Hasan, Goshtha Gopal Biswas. 2024. The effects of Mn doping on structural, morphological, and optical properties of hydrothermally synthesized h-MoO₃ nanorods, *Ceramics International*, Volume 50, Issue 7, Part B, Pages 11565-11574

INSTITUTE OF NUCLEAR MINERALS (INM), AERE

Book

284. Akon, E, Kabir, M.Z. and Zaman, M.N. *Placer Deposits of Bangladesh and Their Potential Commercialization*, Book Chapter, CRC Press, Taylor & Francis Group.

National/International

285. Zhao, Qi; Liu, Mengxian; Moniruzzaman, Md; Shih, Kaimin. 2023. Quantitative assessment of the dissociation behavior of Eu(III) with humic acid under varying pH, ionic strength, and aging periods using a modified dispersed dissociation model, *Chemical Engineering Journal*, Vol. 476, 146932, IF 15.10
286. T. Saha, P. Debnath, M. F. Hossain, M M. Karim, M. Rajib. 2023. Periodic monitoring of physical parameters of groundwater at Cox's Bazar coast, Bangladesh: Possible influence of sub surface heavy mineral deposit, *J. Env. Issues Climate Change*, (2023); Accepted on 13.12.
287. S. Hossain, M. A. N. Tushar, S. Islam, M. Z. A. Razzak, S. Hossain and M. Rajib. 2023. Landslide susceptibility analysis of geological formations: A case study of the Dupi Tila Formation in the Rangamati area, *The Dhaka Univ. J. Earth Env. Sc.*, Vol. 11 (2) (2023), doi: <https://doi.org/10.3329/dujees.v11i2.68818>.

INSTITUTE OF NUCLEAR MEDICAL PHYSICS

National/International

288. Md Raghib Rahat, Homaira Afia Mimi, Shah Azharul Islam, Md Kamruzzaman, Jannatul Ferdous, Mahfuza Begum, Md Abul Hasnat, Hairul Azhar Abdul-Rashid, Umme Muslima, Mayeen Uddin Khandaker, DA Bradley, Md Al-Mamun, AKM Mizanur Rahman. 2023. Synthesis, characterization and thermoluminescence properties of LiCaPO₄ phosphor for ionizing radiation dosimetry, *Applied Radiation and Isotopes*, Vol:202, 1/12
289. Ashrafun Nahar Monika, Rajada Khatun, Shirin Akter, Md Abul Hasnat, Md Mahfuzur Rahman, Mohammad Monjur Ahasan. 2024. A Comparison Study of the Solid Phantom and Water Phantom Using 6 MV and 15 MV Photon Energies, Depending on the Depth, *Bangladesh J. Nuclear Med.*:

Internal Report

290. Md. Masud Parvej, Abul Hasnat, Mst. Sarmin Sultana, Abdur Rahim, M. Rafiqul Ialam. Evaluation of the Shielding Thickness for Primary and Secondary Barriers of the new Bunker of LINAC at the INMP -Technical Report-2022 of AERE
291. Watabe H, Sato T, Yu KN, Zivkovic M, Krstic D, Nikezic D, Kim KM, Yamaya T, Kawachi N, Tanaka H, Haque AK. Development of DynamicMC for PHITS Monte Carlo package. *Radiation Protection Dosimetry*. 2024 Feb;200(2):130-42.
292. Watabe H, Yu PK, Tse G, Krstic DZ, Nikezic DR, Islam MR, Wei Z, Wei Y, Shahmohammadi Beni M. Monte Carlo modelling of Cyclotron and Radioisotope Center (CYRIC) at Tohoku University: A Radiation Protection Study. *Journal of Radiological Protection*. 2024 Jun 5.

293. Jamal N, Krisanachinda A, Tsapaki V, Islam MR, Pawiro S, Al Omari M, Yeong CH, Myint TT, Kakakhel MB, Kharita MH, Lee CL. Strengthening education and training programmes for medical physics in Asia and the Pacific: the IAEA non-agreement technical cooperation (TC) regional RAS6088 project. *Physical and Engineering Sciences in Medicine*. 2024 May 28:1-0.
294. Md. Masud Parvej, Abul Hasnat, Mst. Sarmin Sultana, Abdur Rahim, Samiul Alim, Priyanka Poddar, M. Rafiqul Islam, M M Ahasan. Determination the Setup Margin (SM) of Planning Target Volume (PTV) of Left Breast Cancer for a Specific LINAC Machine. - Technical Report-2022 of AERE

ATOMIC ENERGY CENTRE (AEC), CHATTOGRAM

National/International

295. S. D. Tuhi, R. Barua, R. Mutsuddi, N. Deb, M.R. Karim, S.Hossain, &M. A. Manchur. 2023. An analysis of simultaneous seasonal variation in different bacterial counts and detection of heavy metals in water and shrimp of the Karnaphuli River, Bangladesh. *Toxicology and Environmental Health Sciences*, 15(3), 239-247.
296. S. I. Bhuian, Manish Debnath, S. Hossain, M.P. Sujan, M.B. Sampa. Development And Evaluation of Risk-Informed-Graded Approaches To Ensure Safe And Secure Trade: Experiences Of Chittagong Sea Port, Bangladesh. International Conference on “Nuclear Security:Shaping the Future (CN-321/EVT2300037).
297. Quazi Muhammad Rashed-Nizam, AKM Saiful Islam Bhuian,Nighat Sultana Resma, Manish Debnath& Md. Ashik Azad Khan Anik. 2024. Spatial distribution of NORMs concentrations and assessing potential risk to inhabitants in western Chattogram, Bangladesh, *International Journal of Environmental Analytical Chemistry*, DOI: 10.1080/03067319.2024.2357749.
298. S. Das, and S.Hossain. 2024. Radon exhalation and health hazard assessment for various ceramic tiles used in Bangladesh. *Journal of the European Radon Association*.DOI: 10.35815/radon.v5.10473
299. Rashmi Roy, Israt Jahin Fariha, Nadira Shobnom, N. K. Das. 2024. Financial Feasibility and Environmental Sustainability of Rooftop Solar PV in Chattogram: A Case Study on Residential, Commercial, and Industrial Buildings. DOI: 10.1109/iCACCESS61735.2024.10499585.IEEE Conference paper: International Conference on Advances in Computing, Communication, Electrical, and Smart Systems (iCACCESS).
300. Md Alauddin Bhuiyan, M. J. Rahman, Rashmi Roy, N. K. Das. 2023. Energy-Neutral Cricket Stadium: The Zahur Ahmed Chowdhury Stadium, Analytical Design, and Computational Modeling. DOI: 10.1109/EICT61409.2023.10427967. IEEE Conference paper: 6th International Conference on Electrical Information and Communication Technology (EICT).
301. Rashmi Roy, N. K. Das, Mrinmoy Dey, M A Matin. 2023. Evaluating Solar Energy as a Viable Solution to Bangladesh's Energy and Environmental Challenges: Opportunities, Constraints, and the Path Forward. Conference paper: 7th International Conference on Mechanical Engineering and Renewable Energy 2023 (ICMERE2023)
302. M.N. Bin-Hasan, M. A Fahad, A. Al Zahid, M. Hasan, A. Rahaman, M. S, Hossain, T. R. Sarker, M. N. Hossain, & N. Khatun. 2024. Heavy Metal Exposure and Health Concerns in Bangladeshi Rivers: a Seasonal Comparison of the Buriganga, Shitalakhya, Meghna, Karnaphuli, and Padma Rivers' Water, Sediment, and Fish. *Pollution*, 10 (2), 677-699. <https://doi.org/10.22059/poll.2024.368080.2137>
303. M. N. Hossain, M. D. Islam, A. Rahman, N. Khatun. 2023. Physicochemical Study and Removal of Chromium from Tannery Effluentby low-Cost Bio-adsorbent. *Journal of Natural and Applied Sciences Pakistan*, Vol 5 (2), 1420-1437

INSTITUTE OF FOOD AND RADIATION BIOLOGY (IFRB), AERE

Agrochemical and Environmental Research Division, IFRB

International

304. Pinkey, P.D., Nesha, M., Bhattacharjee, S., Chowdhury, M.A.Z., Fardous, Z., Bari, L. and Koley, N.J. 2024. Toxicity risks associated with heavy metals to fish species in the Transboundary River–Linked

Ramsar Conservation Site of Tanguar Haor, Bangladesh. Ecotoxicology and Environmental Safety, 269, p.115736.

Food Safety and Quality Analysis Division, IFRB

National/International

305. M. A. Khatun, J. Yoshimura, M. Yoshida, Y. Suzuki, R. Huque, S.D Kelly, M. K. Munshi. 2023. Isotopic characteristics ($\delta^{13}\text{C}$, $\delta^{15}\text{N}$, and $\delta^{18}\text{O}$) of honey from Bangladesh retail markets: Investigating sugar manipulation, botanical and geographical authentication. Food chem., 435, 137612. <https://doi.org/10.1016/j.foodchem.2023.137612>.
306. E.J. Park, M. S. Hussain, F. Elahi, A. Hossain, D. H. Oh. 2023. Role of *Bacillus cereus* biofilm formation behavior in virulence and pathogenic characteristics, Wiley, J. Food Safety, 43 (6):e13088.
307. M. S. Mia, M. Islam, R. Huque, M. K. Ahamed, M. Nahar, M. A. Khan, M. M. Islam, A. K. M. R. K. Zoardar, and M.E. Molla. 2023. Potential usage of gamma radiation on sensory evaluation, biochemical properties along with heavy metals analysis of dietary fiber obtained from pineapple peel. J. Nucl. and Related Tech., 20 (2), 76-88.
308. M.B. Sultan, M.M. Rahman, M.A. Khatun, M. Shahjalal, M.A. Akbor, M.A. Siddique, R. Huque, G. Malafaia. 2023. Microplastics in different fish and shellfish species in the mangrove estuary of Bangladesh and evaluation of human exposure. Sci.total.environ, 858, Part1, 159754, <https://doi.org/10.1016/j.scitotenv.2022.159754>.
309. Nawar, N., Rahman, M. M., Chowdhury, F. N., Marzia, S., Ali, M. M., Akbor, M. A., Siddique, M. A. B., Khatun, M. A., Shahjalal, M., Huque, R., & Malafaia, G. 2023. Characterization of microplastic pollution in the Pasur river of the Sundarbans ecosystem (Bangladesh) with emphasis on water, sediments, and fish. Sci.total.environ, 868, 161704. <https://doi.org/10.1016/j.scitotenv.2023.161704>.
310. M. S. Islam, A. Hossain, M. Islam, M. K. Munshi, M. S. Hussain, K. C. Das, I. Ahmed, M. S. I. Khan, R. Huque. 2023. Impact of gamma radiation, potassium sorbate and low temperature on shrimp (*Penaeus monodon*) preservation. Heliyon 8

Insect Biotechnology Division, IFRB

International

311. A. Ghosh, M. F. Hossain, A. Z. A Bhuiyan, and K. Seheli. 2024. Impact of three different types of water media on the life stages of *Aedes aegypti* under laboratory conditions. International Journal of Educational Research and Studies, 6(1), pp. 34-39.
312. M. Khan, D. Hancock, M. A. Bari, J. Lin., and Q. Ji. 2024. Detection of Tephritid Fruit Flies using Food Attractants Baited Trap in Bangladesh. Acad. J. Entomol., 17(1), (2024), pp. 01-06.

Microbiology and Industrial Irradiation Division

National/International

313. Shashwata Biswas, Takeo Kuwata, Soichiro Yamauchi, Kyo Okazaki, Yu Kaku, Md. Zahid Hasan, Hiroshi Morioka, Shuzo Matsushita. 2023. Idiotopes of antibodies against HIV-1 CD4-induced epitope shared with those against microorganisms. Immunology, 4 December 2023, 2024:1-15

Radiation Entomology and Acarology Division, IFRB

International

314. A.T.M.F. Islam, Md. Mosharraf Hosain, Md. Shahinur Islam, Muhsina Yasmin, Akira Yamanaka. 2024. Record of Butterflies of St. Martin's Island, Teknaf, Cox's Bazar, Bangladesh. *International journal of Bioscience*; 24 (5) p. 15-24.
315. Md. Shahinur Islam, Md. Mosharraf Hosain, Muhsina Yasmin, Akira Yamanaka, ATMF Islam. 2023. Life history of the Hog Plum Beetle, *Podontia quatuordecimpunctata* (Linnaeus, 1767) (Coleoptera: Chrysomelidae) with photographs of each developmental stage. *International Journal of Biosciences* Vol. 22, No. 2, p. 1-13.

Veterinary Drug Residue Analysis Division

International

316. D. Chakma, M. M. B. Prince, M. H. Islam, M. S. U. Talukder, C. K. Shaha, M. M. Nabi, M. A. Mannan, M. J. Islam, M. N. Islam, W. Reybroeck, J. J. Sasanya and A.S.M. Saifullah. 2024. Screening for Antimicrobial Residues in Chicken Muscles in Dhaka Division of Bangladesh using Charm II Radio-Receptor Assay. Submitted as conference proceedings of International Food Safety Symposium through the IAEA publications.

Internal Report

317. M. N. Islam, M. H. Islam, M. J. Islam, M. M. B. Prince, D. Chakma, C. K. Shaha, M. A. Mannan and A. S. M. Saifullah. 2022. Development of HPLC-FLD Method for Determination of Aflatoxin B1 and Aflatoxin B2 in Mung Bean. *AERE Technical report*. 28: 208-211.
318. Chironjit Kumar Shaha, M. Jahurul Islam, Rayan-Ul-Islam, M. Hedayetul Islam, M. Nazrul Islam, Maroof Billah Prince, Darmin Chakma, ASM Saifullah. 2022. Optimization of a Solid-Phase Extraction Method for the Determination of Tetracyclines Residues in Chicken Egg Using LC-MS/MS System. *AERE Technical report*. 28: 211-215.
319. Darmin Chakma, MMB Prince, Md. Hedayetul Islam, Md. Jahurul Islam, Md. Nazrul Islam, Md. SU Talukder, CK Shaha, MA Mannan, and A.S.M. Saifullah. 2022. Screening of Milk samples for CAP (Chloramphenicol) residues using CHARM II System. *AERE Technical report*. 28: 215-221.

Plant Biotechnology and Genetic Engineering Division, IFRB

National/International

320. Das, P., Sen, S.K., Manir, M.S. *et al.* 2024. Impact of TiO₂ Nanoparticles on Seed Germination and Growth of Nonabokra Rice, Mortality of Bean Weevil, and Antibacterial and Cytotoxic Activity. *BioNanoSci.* 14, 102–118 (2024). <https://doi.org/10.1007/s12668-023-01273-0>
321. M. H. Kabir, Monirul Islam, Pronabananda Das, N. Hassan and A. N. K. Mamun. 2024. Establishment of plant regeneration protocol through callus induction of sugarcane (*Saccharum officinarum* L.) var. China using leaf-sheath. *GSC Biological and Pharmaceutical Sciences*, 27(01), 287–294.
322. M.H. Kabir, Md. Monirul Islam, Pronabananda Das and ANK Mamun. 2024. *In vitro* regeneration of exotic fruit dragon (*Hylocereus undatus*) from stem fraction. *International Journal of Biological and Pharmaceutical Sciences Archive*, 07(01), 040–047.
323. Islam, M.M.; Rahman, M.F.; Islam, A.; Afroz, M.S.; Mamun, M.A.; Rahman, M.M.; Maniruzzaman, M.; Xu, L.; Sakamoto, T.; Takahashi, Y.; et al. 2024. Elucidating Gender-Specific Distribution of Imipramine, Chloroquine, and Their Metabolites in Mice Kidney Tissues through AP-MALDI-MSI. *Int. J. Mol. Sci.* 2024, 25, 4840. <https://doi.org/10.3390/ijms2509484>
324. Md. Monirul Islam, Shin-ichiro Agake, Takehiro Ito, Safiullah Habibi, Michiko Yasuda, Tetsuya Yamada, Gary Stacey, Naoko Ohkama-Ohtsu. 2024. Involvement of Peptidoglycan Receptor Proteins in Mediating the Growth-Promoting Effects of *Bacillus pumilus* TUAT1 in *Arabidopsis thaliana*, *Plant and Cell Physiology*, Volume 65, Issue 5, Pages 748–761, <https://doi.org/10.1093/pcp/pcae016>

INSTITUTE OF TISSUE BANKING AND BIOMATERIAL RESEARCH

International

325. Polash Chandra Karmakar, Monira Islam Chamely, Tusher -Al-Arafat, Marina Khatun, Naznin Akhtar, S. M. Asaduzzaman. 2023. Silver Nanoparticle-Incorporated Hydroxyapatite-Chitosan-PVP-Based Scaffold for Bone Tissue Engineering: Physicochemical Characterization, Antibacterial Activity, and In Vitro Ceftriaxone. *Advances in Materials Science and Engineering*. 2023 Octo 30;2023(1):9234962. <https://doi.org/10.1155/2023/9234962>.
326. Tusher-Al-Arafat, Shawon Ahmed, Polash Chandra Karmakar, Umme Salma Zohora, Naznin Akhtar, S. M. Asaduzzaman. 2023. Effects of Gamma Irradiation on the Properties of Hydroxyapatite-Collagen-Chitosan-Mg-ZnO Scaffolds for Bone Tissue Engineering. *International Journal of Polymer Science* 2023 Novem 11;2023(1):6682223. <https://doi.org/10.1155/2023/6682223>.

Technical reports

327. Microbial Quality Assurance for Risk-free and Clinically Safe Transplantation with Irradiated Human Tissue Allografts. F. Diba, M.H. Adnan, P.C. Karmakar, T.A. Arafat, N. Akhtar, S.M. Asaduzzaman
328. Human Amniotic membrane allografts for the repair of damaged skin and soft tissues: Collection, Preparation, Preservation. M. H. Adnan, F. Diba, T.A. Arafat, P.C. Karmakar, N. Akhtar, S.M. Asaduzzaman
329. Human Demineralized Bone Matrix after Gamma Irradiation: Procurement, Preservation, and Clinical Use in Maxillofacial Bone Reconstruction. P.C. Karmakar, T.A. Arafat, F. Diba, M.H. Adnan, N. Akhtar, S.M. Asaduzzaman
330. Large Skeletal Defect Reconstruction and Tumor Surgery: Massive Bone Allografts Procurements, Processing, and Preservation for the Clinical Use. T.A. Arafat, P.C. Karmakar, F. Diba, M.H. Adnan, N. Akhtar, S.M. Asaduzzaman
331. Preparation and Preserving Allogeneic Cancellous Bone Chips for Tissue Remodeling and Osteoconductive Bone Gap Filler. P.C. Karmakar, M. H. Adnan, T.A. Arafat, F. Diba, N. Akhtar, S.M. Asaduzzaman
332. Autologous Bone Flaps for Skull Defect Repair Processed and Banked After Gamma-irradiation. T.A. Arafat, F. Diba, M.H. Adnan, P.C. Karmakar, N. Akhtar, S.M. Asaduzzaman

NATIONAL INSTITUTE OF NUCLEAR MEDICINE AND ALLIED SCIENCES (NINMAS), SHAHBAG
International Publications

333. S. Jahan, J. Ferdous, M. M. H. Prodhan, Ferdoushi Begum. 2024. Evaluating internal exposure due to intake of ¹³¹ I at a Nuclear Medicine Centre of Dhaka using bioassay methods, Nucl. Engr. Technology, Elsevier B. V., 56, 2050-2056.

National Publications

334. P. Akhter, F. Begum, J. Ferdous. 2023. Analysis of association between basic and clinicopathological characteristics of papillary thyroid carcinoma patients' brave mutation, Bangladesh J. of Nucl. Med., 26(2), 119-123.
335. J. Ferdous, P. Akhter, Z. Jabin, S. Sarkar, M. Sajjad-Al-Mishal, U. Islam, F. Begum. 2023. Age related clinical outcome after radioiodine ablation therapy in patients with papillary thyroid carcinoma with lymph node metastases, Bang. J. of Nucl. Med., 26(2), 133-139.
336. S. Sarkar, S. N. Bailey, J. Ferdous, M. Sajjad-Al-Mishal, F. Begum. 2023. Referral patern of 99m technetium thyroid scan patients with suspected subacute thyroiditis before and after the covid-19 period, Bangladesh J. of Nucl. Med., 26(2), 155-159.
337. R. Purveen, Z. Jabin, U. S. Urmi, S. Roy, P. Jabin, A. Anar, T. K. Konika. 2023. Clinical significance of diffuse hepatic uptake on post-therapeutic 131i-whole body scan in differentiated thyroid cancer, Bangladesh J. of Nucl. Med., 26(2), 160-166.
338. A. Chaudhury, Z. Jabin, S. Selim, A. Naznin, M. Hasan. 2023. Association of thyroid antibodies with occurrence of hypothyroidism after radio-iodine therapy in patients with graves' disease attending a tertiary level hospital of Bangladesh, Bangladesh J. of Nucl. Med., 26(2), 167-171.
339. T. Mandal, P. Mutsuddy, P. Akhter, A. Rahman, Mohammad Sajjad-Al-Mishal, M. Abu B. Siddique, S. M. F Begum, Assessment of extranodal lymphoma by 18F FDG PET-CT- a report of two years in NINMAS, Bangladesh J. of Nucl. Med., 26(2), 177-183
340. S. Islam, Mohammad Anwar-Ul-Azim, M. J. Uddin, S. C. Biswasarma, M. S. Islam, T. Mandal, M. Manun, S. Khatun, M. S. Islam, Most. L. S. Banu. 2023. Evaluation of the lyophilized MIBI kits fraction for 99m Tc labeling: a cost – effective approach for labeling cold kits in nuclear medicine practice, Bangladesh J. of Nucl. Med., 26(2), 188-192.
341. M. S. Islam, M. Anwar-Ul-Azim, M. J. Uddin, S. C. Biswasarma, S. Islam, Most. L. S. Banu, M. S. Mia, H. Mehdi, Nur-E-Alam Siddique, M. Kadir. 2023. Routine R. quality control of 99m Tc eluate and 99mTc-labeled radiopharmaceuticals, Bangladesh J. of Nucl. Med., 26(2), 193-197.

342. M. J. Uddin, M. Anwar-Ul-Azim, S. C. Biswasarma, M. S. Islam, S. Islam, M. Manun, F. Begum, M. N. Hossain, M. S. Mia, H. Mehdi, Nur-E-Alam Siddique, M. Kadir. 2023. Radiosynthesis and quality control of (18F) PSMA- 1007 at the cyclotron facility of National Institute of Nuclear Medicine and Allied Sciences (NINMAS) for diagnosis of prostate cancer, Bangladesh J. of Nucl. Med., 26(1), 198-200.
343. U. Islam, S. Quddus, S. Reza, N. Sultana, F. Akter, S. Sultana. 2023. One year Observations of HIDA Scans at NINMAS, Bangladesh. 15th Asia Oceania Congress of Nuclear Medicine and Biology (AOFNMB). 11, 91.
344. S. N. Bailey, J. Ferdous, N. F. Ali, S. Sarkar, Z. Jabin, F. Begum. 2023. Analysis of Referral Pattern of Thyroid Disorder in Children in a Tertiary Nuclear Medicine Institute of a Developing Country. Asia Oceania Jr. of Nucl. Med. and Biol., 11(supl.1), 89.
345. S. Alam, R. Parveen, S. Reza, S. Sultana, U. Islam, S. N. Bailey, R. Parveen, F. Akter, M. S. Islam, N. Sultana. 2024. Homsy's sign in DTPA renogram- initial experience at NINMAS, Bangladesh J. of Nucl. Med., 27(1), 21-26.
346. U. Islam, S. Reza, S. M. Adnan, M. S. A. Chowdhury, S. N. Bailey, R. Parveen, F. R. Ananna, N. Sultana. 2024. The outcomes and success rates of kasai operation for biliary atresia cases using presurgical hepatobiliary scan: observations At NINMAS, Bangladesh J. of Nucl. Med., 27(1), 44-48.
347. A. Anar, S. M. Adnan, N. Sultana. 2024. Association between Carotid Intima-Media Thickness (CIMT) and Alzheimer's Disease detected by 99mTC-ECD SPECT of Brain, Bangladesh J. of Nucl. Med., 27(1), 49-55.
348. F. R. Ananna, U. Islam, R. Parveen, S. Reza, S. M. Adnan, S. N. Bailey, N. Sultana. 2024. Bone scintigraphic pattern and correlation with serum prostate specific antigen levels in prostate cancer patients at NINMAS, Bangladesh J. of Nucl. Med., 27(1), 56-61.
349. P. Jabin, F. Nasreen, M. M. Hassan, U. Salma, T. K. Konika, R. Purveen, S. Roy. 2024. Correlation of B-mode and doppler ultrasound parameters of kidney with serum creatinine level in chronic kidney disease patients. Bangladesh J. of Nucl. Med., 27(1), 62-68.
350. S. Sultana, R. Parveen, S. Reza, S. Alam, T. Sultana, U. Islam, S. N. Bailey, R. Parveen, M. S. Islam, N. Sultana. 2024. Definitive diagnosis of hepatic hemangioma by 99m tc labeled red blood cell spect and comparative analysis with ultrasound. Bang. J. of Nucl. Med., 27(1), 69-74.
351. S. N. Bailey, F. Jisan, L. Nahar, U. Islam, S. M. Adnan, S. Reza, R. Parveen, N. F. Ali, N. Sultana. A Comprehensive analysis of lymphoscintigraphy results for lower limb edema in pediatric group of patients at NINMAS. Bangladesh J. of Nucl. Med., 27(1), 75-80.
352. M. Anwar-Ul-Azim, S. C. Biswasarma, M. A. Islam, M. J. Uddin, S. Islam, M. S. Islam, F. Begum, M. Mamun, S. Khatun, M. Alamgir Kabir, M. S. I. Akand, N. Hossain, J. Ferdous, F. Begum, S. M. F. Begum, Z. Jabin. 2024. Newborn screening for the early detection of congenital hypothyroidism: a countrywide comprehensive program of Bangladesh Atomic Energy Commission. Bangladesh J. of Nucl. Med., 27(1), 81-88.
353. S. C. Biswasarma, M. Anwar-Ul-Azim, P. Podder, M. J. Uddin, S. Islam, M. S. Islam, M. Manun, S. Khatun. 2024. Prevalence and Determinants of Vitamin D Deficiency: a comprehensive analysis from the measured Vitamin D level at Chemiluminescence Immunoassay (CLIA) laboratory of National Institute of Nuclear Medicine and Allied sciences (NINMAS), Dhaka. Bangladesh J. of Nucl. Med., 27(1), 89-94.
354. T. Mandal, S. Sultana, S. M. F Begum, S. I. K. Banergee, C. M. Ahmed. 2024. 18F FDG PET Cardiac Imaging for Myocardial Viability Assessment in NINMAS. Bangladesh J. of Nucl. Med., 27(1), 95-99.

Case Reports

355. J. Ferdous, S. N. Bailey, S. Sarkar, M. Sajjad-Al-Mishal, F. Begum. 2023. Recurrence of papillary thyroid carcinoma associated with mucoepidermoid carcinoma: an uncommon case report. Bangladesh J. of Nucl. Med. 26 (2), 204-209.

356. S. Munira, F. Rahman, R. Parveen, U. Islam, N. Sultana. 2023. Spontaneous biliary duct perforation: uncommon diagnosis using cholescintigraphy, Bangladesh J. of Nucl. Med. 26 (2), 215-217.
357. M. Sajjad-Al-Mishal, P. Akhter, P. Mutsuddy, T. Mandal, S. M. A. Rahman, M. A. B. Siddique, S. M. F. Begum. 2023. Bilateral renal lymphoma detected by 18F-FDG Pet/CT scan: a case report. Bangladesh J. of Nucl. Med. 26 (2), 229-232.
358. T. Ahmed, F. Begum, J. Ferdous, U. Islam, K. Tushra, S. Munira. 2023. Refusal of radioiodine ablation in a patient with inoperable locally advanced metastatic papillary thyroid carcinoma: a case report. Bangladesh J. of Nucl. Med. 26(2), 233-236.
359. S. Quddus, T. Mandal, S. Reza, N. Sultana, R. Parveen, U. Islam, S. Sultana. 2024. SPECT myocardial perfusion imaging in the diagnosis of apical hypertrophic cardiomyopathy- case series and literature review. Bangladesh J. of Nucl. Med. 27(1), 100-106.
360. P. Akhter, P. Mutsuddy, T. Mandal, M. Sajjad-Al-Mishal, S. M. A. Rahman, M. A. B. Siddique, S. M. F. Begum. 2024. 18F FDG PET/CT findings in a patient with sarcoidosis: a case report. Bangladesh J. of Nucl. Med. 27(1), 107-111.
361. S. Munira, T. Mandal, S. Sultana. Paradoxical myocardial perfusion imaging pattern in cardiac patient: two case reports. Bangladesh J. of Nucl. Med. 27(1), 117-120.
362. S. M. A. Rahman, T. Mandal, P. Akhter, M. Sajjad-Al-Mishal, P. Mutsuddy, M. A. B. Siddique, S. M. F. Begum. 2024. Incidental finding of mesenteric cyst by 18F FDG PET-CT: case report. Bangladesh J. of Nucl. Med. 27(1), 127-129.
363. S. M. Adnan, J. Ara Shefa, M. B. Alam, N. Sultana. 2024. Assessment of perfusion abnormalities in a case of autism spectrum disorders using 99m Tc ECD Brain SPECT: a landmark case in Bangladesh. Bangladesh J. of Nucl. Med. 27(1), 130-133.
364. R. Parveen. S. Alam, M. F. Akter, S. Sultana, S. N. Bailey, S. Reza, R. Parveen, N. Sultana. 2024. Avascular necrosis of femoral head in bone scintigraphy with concurrent parathyroid adenoma diagnosed by parathyroid SPECT/CT- a case report. Bangladesh J. of Nucl. Med. 27(1), 134-137.
365. J. Ferdous, F. Begum, P. Akter, S. N. Bailey, Z. Jabin, 2023. breast metastases from papillary thyroid carcinoma: case report on the importance of ultrasound imaging, Bangladesh J. of Ultras., 24(1&2), 51-55.
366. S. Munira, P. Akhter, J. Ferdous, T. Mandal, N. Sultana, 2023. Spontaneous abdominal wall endometriosis: a diagnostic enigma, Bangladesh J. of Ultras., 24(1&2), 56-58.
367. P. Akhter, P. Mutsuddy, J. Ferdous, T. Mandal, S. M. A. Rahman, M. A. B. Siddique. 2023. Successful Pregnarcy outcome in herlyn-werner-wunderlich syndrome: a case report, Bangladesh J. of Ultras., 24(1&2), 65-70.
368. A. B. Siddique, T. Ahmed. Iv'lohamrlad S. Salekin, Z. Jabina. 2023. Incidental ultrasonographic diagnosis of intussusception in a child, Bangladesh J. of Ultras., 24(1&2), 71-73.
369. S. M. A. Rahman, P. Akhter, P. Mutsuddy, T. Mandal, S. Munira, M. A. B. Siddique. 2023. Incidental finding of hepatic adenoma: a case report, Bangladesh J. of Ultras., 24(1&2), 77-80.

INSTITUTE OF NUCLEAR MEDICINE AND ALLIED SCIENCES (INMAS), DHAKA

370. Rawnak Afrin, Shankar Biswas, Shamim Momtaz Ferdousi Begum, Shaila Sharmin, Farhana Rahman1, Sadia Hossain, Afroza Akhter, Mohana Hossain, Rubina Begum, Sabrina Islam, Tania Sultana, Tanima Biswas, Jasmine Ara Haque. 2024. Role of 18F-FDG PET/CT in patients with primary extranodal lymphoma.”, J. Nucl. Med. Vol. 27 No.
371. Sadia Hossain, Farhana Rahman, Rawnak Afrin, Afroza Afrin, Shanker Biswas, Tanima Biswas, Tania Sultana, Sabrina Islam, Shaila Sharmin, Rubina Begum, Mohona Hossain, Jasmine Ara Haque, Asif Rashed. 2024. Baseline PET-CT evaluation of Bone Marrow-Liver-Spleen Type of Diffuse Large B-Cell Lymphoma: A Rare Aggressive Extranodal Lymphoma.”, J. Nucl. Med. Vol. 27 No. 1
372. Shankar Kumar Biswas*, Afroza Akhter, Farhana Rahman, Sadia Hossain, Rawnak Afrin, Tanima Biswas, Shaila Sharmin, Mohana Hossain, AKM Monwarul Islam, Jasmine Ara Haque. 2024. Nuclear

cardiology for the evaluation of infiltrative cardiomyopathy: Highlighting cardiac amyloidosis and sarcoidosis. , J. Nucl. Med. Vol. 27 No. 1

373. froza Akhter, Shaila Sharmin, Farhana Rahman, Sabrina Islam, Sadia Hossain, Rawnak Afrin, Tanima Biswas, Rubina Begum, Shankar Kumar Biswas, Jasmine Ara Haque, Mohammad Ashraf Us Zaman Mahmud. 2024. The Intricate Diagnostic Journey of a Breast Cancer Patient, Revealing Extensive Hepatic Metastasis Through Extraosseous Uptake in Planar Bone Scintigraphy and SPECT-CT Precision Mapping, J. Nucl. Med. Vol. 27 No. 1
374. Sabrina Islam, Afroza Akhter, Tanima Biswas, Shaila Sharmin, Rawnak Afrin, Mohona Hossain, Sadia Hossain, Farhana Rahman, Tania Sultana, Rubina Begum, Shankar Kumar Biswas, Jasmine Ara Haque. 2024. Diagnostic precision and evaluation of therapeutic response with 99mTc MDP bone SPECT-CT in a unique case of osteosclerotic metastasis from lung adenocarcinoma: A case report., J. Nucl. Med. Vol. 27 No. 1
375. Tania Sultana, Md Sanowar Hossain, Sadia Sultana, Afroza Akhter, Shaila Sharmin, Farhana Rahman, Sadia Hossain, Mohana Hossain, Rawnak Afrin, Shankar Kumar Biswas, Rubina Begum, Mizanur Rahman, Jasmine Ara Haque. 2024. Evaluation of Surgical Outcome of Pelviureteric Junction Obstructive Patients by 99mTc-DTPA Renography, J. Nucl. Med. Vol. 27 No. 1
376. Afroza Akhter, Shankar Biswas, Shaila Sharmin, Rawnak Afrin, Farhana Rahman, Sadia Hossain, Jasmine Ara Haque and Sabrina Islam. 2024. Beyond the Obvious: Navigating a Cardiovascular Dilemma in a Young Male with Non-Obstructive Hypertrophic Cardiomyopathy and Incidental Polycystic Kidney Disease, (JNM), 65 (Supplement 2) 241745
377. Afroza Akhter, Shankar Kumar Biswas, Shaila Sharmin, Farhana Rahman, Rawnak Afrin, Sadia Hossain, Mohana Hossain, Tanima Biswas, Tania Sultana, Sabrina Islam, Rubina Begum, Jasmine Ara Haque, A KM Monwarul Islam. 2024. Detection of two distinct pathologies with similar clinical presentations using nuclear imaging technique in infiltrative cardiomyopathy: A case study of two female patients, J. Nucl. Med. Vol. 27 No. 1

INSTITUTE OF NUCLEAR MEDICINE AND ALLIED SCIENCENS (INMAS), CHATTOGRAM

National/International

378. Al Persi A, Muhtasim MF, Alim NE, Hossain MS, Akter AA, Bhattacharjee PK. 2023. Osteoporosis in an Adolescent Female: A Case Report. Bangladesh Journal of Nuclear Medicine., 26(2):210-4.
379. Muhtasim MF, Al Persi A, Khan MN, Alim NE, Hossain MS, Akhter AA, Bhattacharjee PK. 2023. Immunotherapy in Radioactive Iodine Refractory Thyroid Cancer–Case Report and Review of Literature. Bangladesh Journal of Nuclear Medicine., 26(2):218-25.
380. Muhtasim MF, Al Persi A, Khan MN, Alim NE, Hossain MS, Bhattacharjee PK. 2023. Investigating Unexpected Shortening of Height of A Middle-Aged Woman: A Case Report. Bangladesh Journal of Nuclear Medicine., 26(1):58-61.

INSTITUTE OF NUCLEAR MEDICINE AND ALLIED SCIENCENS (INMAS), MYMENSINGH

National

381. Shakila Zaman Rima, Nayema Rahman Anu, Fahima Akter Dowel, Rawshan Ara, Nazmun Nahar, Md Nadiruzzaman, Ratan Kumar Chakraborty, Nasim Khan. 2023. Extensive Liver Fibrosis due to Hepatic Iron Over Load Mimicking Multiple Mass Lesions in a patient with Thalassaemia-A Rare Case Report (Abstract), Bangladesh Journal of Ultrasonography.
382. Rowshan Ara, M Nasim Khan, Ratan Kumar Chacraborty, Shakila Zaman Rima, Nazmun Nahar, Fahima Akhter Dowel, Nayema Rahman Anu, Md. Mahbubur Rahman. 2024. Unusual Bone Metastases in Sinunasal Squamous Cell Carcinoma on SPECT-CT Bone Scintigraphy: A rare case report: Bangladesh J. Nucl. Med. Vol. 27 No.1, Page-151.

INSTITUTE OF NUCLEAR MEDICINE AND ALLIED SCIENCES (INMAS), RAJSHAHI

National/International

383. S.N.Alam, M.S.Ahsan, N. Begum, P. Ahmed, T.Ahmed, S.I.Chowdhury. 2023. Pattern of ^{99m}Tc-DTPA Renogram Findings in pediatric Patients attending, INMAS, Rajshahi, BJNM, Vol.26, 184-187.
384. T. Ahmed, M.S. Ahsan, N. Begum, T. Ahmed, P. Ahmed, S.N.Alam, S.I. Chowdhury. 2024. Relationship between PSA level and bone metastasis in newly diagnosed prostate cancer patients referred to INMAS, Rajshahi for bone sca , BJNM, Vol. 27.
385. F.U.Ahmad, N. Begum, M.S.Ahsan, P. Ahmed. T. Ahmed, S.N.Alam, S. Mahmud. 2024. Warthin's Tumor of Parotid gland: A Case Report, BJU, Vol. 24, 1-2.
386. N. Begum, M.S. Ahsan, S.N. Alam, P. Ahmed, T. Ahmed, N. Amir. 2023. Prenatal Diagnosis of Ranula: A Social Rescue, BSU.

INSTITUTE OF NUCLEAR MEDICINE AND ALLIED SCIENCES (INMAS), BARISHAL

National/International

387. Mohammad Anwar Ul Azim, Sanchoy Chandra Biswasarma, Md Ariful Islam et al. 2024. Newborn Screening for the Early Detection of Congenital Hypothyroidism: A Countrywide Comprehensive Program of Bangladesh Atomic Energy Commission.. Bangladesh J. Nuc. Med. Vol. 27, No.1, 81-88,
388. S. Hossen, N Jahan, F Sharmin, N. Jahan. 2023. Black Pigmentation of Tongue Following Radioactive Iodine Therapy: An Interesting & Extremely Rare Case Report, Bangladesh J. Nuc. Med.. Vol. 26, No.2, 226-228.

INSTITUTE OF NUCLEAR MEDICINE AND ALLIED SCIENCES (INMAS), FARIDPUR

National/International

389. Hafizur Rahman, Abdul Aziz, Zeenat Jabin. 2023. Fetal Anomaly Scan Ultrasound: Bedside, Non-invasive imaging modality and Essential Component of Prenatal Care. Bangladesh J.ultraso.vol.24, no. 1 & 2.

INSTITUTE OF NUCLEAR MEDICINE AND ALLIED SCIENCES (INMAS), BOGURA

National/International

390. Awal MA, Chowdhury SA, Hossain MF, Marjan GA. 2023. Sonographic Detection of Fetal Sex in Rural & Urban Area of Bangladesh and its Correlation with General Population at Census, Journal of Shaheed Ziaur Rahman Medical College. Vol. No. 40. PP-20-22.
391. Awal MA, Chowdhury MSA, Rahman MMU, Sarmin S, Hossain MF, Mamun MA. 2023. Distribution Pattern of Skeletal Metastatic Lesions in Lung Cancer Patients, Journal of Shaheed Ziaur Rahman Medical College. Vol. No. 41. PP-19-23.
392. Md. Sunny Anam Chowdhury, Sujon Mahmud, Fariha Zerine, Yeasmin Akter, Baharul Hasan, Md. Abdul Awal, Suraya Sarmin, Md. Al Mamun, Md. Faruk Hossain, Nazia Tarannum, Md. Sifat Meftaul Jannat. 2023. Pregnancy outcome and health status of the offspring of the female patients accidentally conceived within two years of radioiodine therapy for differentiated thyroid cancer (2023). Bangladesh Journal of Nuclear Medicine. Vol. No. 27. PP-139-143.
393. Md. Faruk Hossain, Md. Sunny Anam Chowdhury, Md. Abdul Awal, Md. Monirul Haque, Suraya Sarmin, Md. Al Mamun, Nazia Tarannum. 2024. Workplace radiation monitoring and analysis: A single institution-based study (2024), Bangladesh Journal of Nuclear Medicine. Vol. No. 27. PP-39-43.

INSTITUTE OF NUCLEAR MEDICINE AND ALLIED SCIENCES (INMAS), CUMILLA

National

394. Dr. M. M. Arif Hosen, Nazmul Hossain, Fahema Farjana Shimu, Shartaz Begum. 2024. Evaluation of thyroid function in patients with gestational diabetes mellitus: Bangladesh J. Nucl. Med. Vol. 27 No. 1.

INSTITUTE OF NUCLEAR MEDICINE AND ALLIED SCIENCES (INMAS), SUHRAWARDY

National

395. Purveen, Rejuana, Zeenat Jabin, Umme Salma Urmi, Sutanu Roy, Prianka Jabin, Ashrafi Anar, and Tasnia Kawsar Konika. "Clinical Significance of Diffuse Hepatic Uptake on Post-Therapeutic ¹³¹I-

Whole Body Scan in Differentiated Thyroid Cancer." Bangladesh Journal of Nuclear Medicine 26, no. 2 (2023): 160-166.

396. Ferdous, Jasmin, Papia Akhter, Zeenat Jabin, Shimul Sarkar, Mohammad Sajjad Al Mishal, and Fatima Begum. 2023. Age Related Clinical Outcome After Radioiodine Ablation Therapy in Patients of Papillary Thyroid Carcinoma with Lymph Node Metastases. Bangladesh Journal of Nuclear Medicine 26, no. 2, 133-139.

INSTITUTE OF NUCLEAR MEDICINE AND ALLIED SCIENCES (INMAS), JASHORE

National/International

397. Alam, A. 2024. Biosensor and Bioelectronics :X Graphene Based Electrochemical Biosensores for Detection of Cardiac Biomarkers. Biosens. Bioelectron, 100515. <https://doi.org/10.1016/j.biosx.2024.100515>.
398. Mou, T.U.Z.; Das, J.; Hossain, M. N.; Uddin, S.M.N.; Pervin, A; Mazid, M. A.; Fiffat, M.; Muttakin, M. S. 2024. Low Parathormone Level After Total Thyroidectomy-Observation of Patient Teaits at A Single Institute, Bangladesh J. Nucl. Med.2021.26 (2), 146-150. <https://doi.org/10.3329/bjnm.v26i2.71482>.

INSTITUTE OF NUCLEAR MEDICINE AND ALLIED SCIENCES (INMAS), KHULNA

National/International

399. MF Hossain, MSA Chowdhury, MA Awal, MM Haque, S Sarmin, MA Mamun, N Tarannum. 2024. Workplace radiation monitoring and analysis: A single institution-based study, Bangladesh J Nucl. Med, Vol.27, No.1. 39-43
400. MSA Chowdhury, S Mahmud, F Zerine, Y Akter, B Hasan, MA Awal, S Sarmin, MA Mamun, MF Hossain, N Tarannum, MSM Jannat. 2023. Pregnancy outcome and health status of the offspring of differentiated thyroid cancer patients, who accidentally conceive within two years of radioiodine ablation therapy, Bangladesh J Nucl. Med, Vol.26, No.2, 140-45
401. F Zerine, S Mahmud, MSM Jannat, Y Akter, B Hasan, MSA Chowdhury. 2023. Early miscarriage of unwanted pregnancy after radioiodine ablation in a patient with Graves' disease: Case report, Bangladesh J Nucl. Med, Vol.26, No.2, 201-03
402. S Mahmud, N Begum, MS Ahsan, P Ahmed, T Ahmed, T Ahmed, SN Alam, FU Ahmed, R Debi, MSA Chowdhury. 2023. Accessory Ovary: A rare case report. Bangladesh J Ultraso, Vol.24, No. 1&2, 81-83
403. MA Awal, MSA Chowdhury, MMU Rahman, S Sarmin, MF Hossain, MA Mamun. 2023. Distribution pattern of skeletal metastatic lesions in lung cancer patients: A study of 196 cases. J Shaheed Ziaur Rahman Med Coll, Vol.41, No.1, 19-23
404. MA Awal, MSA Chowdhury, MF Hossain, GA Marjan. 2023. Sonographic detection of fetal sex in rural and urban area of Bangladesh and its correlation with general population at census, J Shaheed Ziaur Rahman Med Coll, Vol.40, No.2,20-22

INSTITUTE OF NUCLEAR MEDICINE AND ALLIED SCIENCES (INMAS), SHATKHIRA

Paper presented in Seminar/Symposium/Conference/Workshop(National/International)

405. Naznin, A. ., Sharmin, S. ., Hossain, J. ., Islam, M. N. ., Salekin, M. S. ., Rahman, H. A. ., & Billah, S. M. B. . (2023). Complementary Role of Thyroid Scintigraphy, Neck Ultrasonography and Biochemical Assay to Delineate Thyroid Disease Pattern in Southern Part of Dhaka. Bangladesh Journal of Nuclear Medicine, 26(1), 31–33. <https://doi.org/10.3329/bjnm.v26i1.64661>
406. Islam, M. N., Hosen, M. M. A., Sharmin, S., Salekin, M. S., Naznin, A., Hossain, J., Rahman, H. A., Nahar, L., Hossain, S., & Uddin, M. I. (2024). A Case Report on Avascular Necrosis of Right Femoral Head in a 20-years Old Male. *SAS Journal of Surgery*, 10(01), 127–130. <https://doi.org/10.36347/sasjs.2024.v10i01.022>

CENTRAL ENGINEERING FACILITIES, AERE

International

407. Md. Nurunnabi, Shah Alimuzzaman Belal, Muhammad Borhan Uddin and Ruhul Amin Khan, "Influence of Graphitic Carbon Nitride (g-C₃N₃) on Mechanical and Thermal Properties of Pineapple

Leaf Fiber Reinforced Polyester Resin Composites: Journal of Textile & Leather Review.2024; 7:433-452. Published 15 March2024, <https://doi.org/10.31881/TLR.2024.001>

408. S.M. Kalbin Salim Turjo, Md. Foisal Hossain, Muhammed Sohel Rana and Md. Shafiul Ferdous, “Mechanical characterization and corrosive impacts of natural fiber reinforced composites: An experimental and numerical approach”, Journal of Polymer Testing, Volume 125, (2023) 108108, <https://doi.org/10.1016/j.polymertesting.2023.108108>.
409. Asif Hosen, Md Foisal Hossain, Muhammed Sohel Rana, Md. Shafiul Ferdous, “Investigation of Flexural Strength of Jute Fiber Based Circular Type Honeycomb Sandwich Panel: An Experimental and Numerical Approach”, Results in Materials, Vol. 19, July 2023. Doi:10.1016/j.rinma.2023.100423.
410. Fatema Ferdous, Md Foisal Hossain, Muhammed Sohel Rana, Md. Shafiul Ferdous, Experimental investigation with FE analysis on flexural strength of hexagonal shaped honeycomb sandwich panel, Modern Physics Letters B, September, 2023, Doi: 10.1142/S0217984924500945.
411. PrantiSaha,Md Foisal Hossain, Muhammed Sohel Rana, Md. Shafiul Ferdous, Numerical Modeling of Kevlar/Jute Fiber Hybrid Composite Pressure Vessels, Carbon Trends, Vol. 13,October,2023, Doi: 10.1016/j.cartre.2023.100304.
412. A. B. M. AbidHossenBhuiyan, Md Foisal Hossain, Muhammed Sohel Rana, Md. Shafiul Ferdous, “Experimental investigation, numerical analysis, and environmental effects on mechanical properties of woven Jute-Kevlar hybrid composites”, Results in Materials, Vol. 20, 15 October, 2023, Doi: 10.1016/j.rinma.2023.100477.
413. MdMafidul Islam, MdFoisal Hossain, Muhammed Sohel Rana, MdShafiul Ferdous, Burst pressure prediction of Carbon/Natural fiber and hybrid composite pressure vessels by theoretical and numerical analysis, Hybrid Advances, Vol. 5, March 2024, Doi: 10.1016/j.hyadv.2024.100172.
414. S M Kalbin Salim Turjo, MdFoisal Hossain, Muhammed Sohel Rana, Md Al-Mamun, MdShafiul Ferdous, “Durability and Mechanical Characteristics of Unidirectional Jute/Banana and Synthetic Fiber Reinforcement Epoxy Composite”, Hybrid Advances, Vol. 6, June 2024, 100232.
415. MdSadbin Azad Alvy, MdFoisal Hossain, Muhammed Sohel Rana,MdMotinur Rahman,MdShafiul Ferdous, “Influence of stacking sequences of woven Jute-Carbon hybrid composites: Diffusion mechanism and mechanical characterization”, Heliyon, 2024.
416. MdShahriarHaque, MdFoisal Hossain, Muhammed Sohel Rana, MdShafiul Ferdous, “Response of Circular Type Sandwich Panel using JUCO-Glass Fiber with PU Foam under Three-Point Bending Loading”, Forces in Mechanics, 2024.
417. Istiak Ahmed, MdFoisal Hossain, Muhammed Sohel Rana, MdShafiul Ferdous, “Mechanical Characterization and Diffusion Analysis of Jute, JUCO, and Banana Fiber Reinforced Epoxy Composites”, Hybrid Advances, 2024

NUCLEAR POWER AND ENERGY DIVISION (NPED), BAEC HQ

National/International

418. Muhammed Mufazzal Hossen, Saikat Ahmed, Mahmud Hossain. 2024. Analyzing Thermal-Hydraulic Parameters During Cold Leg Loss of Coolant Accident Without Reactor Scram Using PCSTRAN model of VVER-1200”, Acta Mechanica Malaysia (AMM), Vol. 7(1), 16-22, pp. 16-22.
419. Md Asaduzzaman, Md Mehedi Hassan, Md Kabir Hossain, Md Shahinoor Alam, Mohammad Omar Faruk, and K M Jalal Uddin Rumi. 2024. “Transient Analysis of LBLOCA with Subsequent Loss of Offsite Power and Loss of All AC Power in VVER-1200 Reactor, The 2nd International Conference on Mechanical Engineering and Applied Sciences 2022 (ICMEAS 2022) 08/12/2022 - 10/12/2022, Dhaka, Bangladesh, IOP Conf. Series: Materials Science and Engineering; Volume 1305 (2024) 012012, IOP Publishing, doi:10.1088/1757-899X/1305/1/012012

CONSTRUCTION OF ROOPPUR NUCLEAR POWER PLANT (RNPP)

International

420. Improving Operational Safety at Nuclear Power Plant through Comprehensive Workforce Development, M. K. Hossain, M. G. S. Islam, M. Omar Faruk, M. S. Akbar, Published in the Proceedings of International Conference on Enhancing the Operational Safety of Nuclear Power Plants, 15-19 April 2024, Beijing, China, Ref: CN-284/EVT2300035

List Of Important Reports Published

421. “First Concrete Pouring of Rooppur Nuclear Power Plant”-Dr. Mohammad Shawkat Akbar, Published by Ministry of Science and Technology, Issue 2017.
422. “First Concrete Pouring Ceremony Rooppur Nuclear Power Plant Second Unit”- Dr. Mohammad Shawkat Akbar, Published by Ministry of Science and Technology, Issue 2018.
423. “Construction of Rooppur Nuclear Power Plant”- Dr. Mohammad Shawkat Akbar, Published by Ministry of Science and Technology, Issue 2019.
424. “Installation of Reactor Vessel for Rooppur Nuclear Power Plant, Unit-1”- Dr. Mohammad Shawkat Akbar, Published by Ministry of Science and Technology, Issue 2021.
425. “Installation of Reactor Vessel for Rooppur Nuclear Power Plant, Unit-1”- Dr. Mohammad Shawkat Akbar, Published by Ministry of Science and Technology, Issue 2022.
426. “Rooppur Nuclear Power Plant: Our dream, our pride”- Dr. Mohammad Shawkat Akbar, Published by Nuclear Power Plant Company Bangladesh Ltd, Issue 2022.
427. “Rooppur: from green field to nuclear power plant”- Dr. Mohammad Shawkat Akbar, Published by Nuclear Power Plant Company Bangladesh Ltd, Issue 2022.
428. “Graduation Ceremony of Rooppur NPP” -Dr. Mohammad Shawkat Akbar, Published by Ministry of Science and Technology, Issue 2023.
429. “Graduation of Rooppur NPP- From Construction To Nuclear Facility” -Dr. Mohammad Shawkat Akbar, Published by Construction of Rooppur Nuclear Power Plant Project, Issue September 2023.
430. “Graduation of Rooppur NPP” Dr. Mohammad Shawkat Akbar, Published by Construction of Rooppur Nuclear Power Plant Project, Issue February 2024

PLANNING AND DEVELOPMENT DIVISION, BAEC

National/International

431. Md Nur E Alam, A. K. M. Atique Ullah, M. Mozammel Hosen, Md Azizul Maksud, Shahidur Rahman Khan, Shamima Akon, Shamshad B. Quraishi, Evaluation of essential and trace metals/metalloids distribution and probable human health risk implications from branded liquid and powder milks available in Dhaka City, Bangladesh, BiOmetals, 2024, <https://doi.org/10.1007/s10534-023-00574-x>
432. MM Hosen, M Nur E Alam, FS Tonni, SR Khan, MA Maksud, LN Lutfu, AKM Ullah, R Begum, Q Nahar, SB Quraishi. Exploration of Toxic and Essential Metals in Popular Rice Grains of Bangladesh and Associated Human Health Risk Implications. Biological Trace Element Research, 1-17, 2023.
433. Tasrina Rabia Choudhury, Thamina Acter, M. Abbas Alam, Sheikh Fahim Faysal Sowrav , M. Safiur Rahman, A.M. Sarwaruddin Chowdhury, Shamshad B. Quraishi, Appraisal of heavy metal contamination and their source apportionment identification in five river water systems of the coastal areas in Bangladesh, Regional Studies in Marine Science 70 (2024) 103378, <https://doi.org/10.1016/j.rsma.2024.103378>
434. Sayed Tariq Uzzaman, Shamshad B. Quraishi, and Salma Begum, “Assessment of Heavy Metals in Johnius Dussumieri (Cuvier, 1830) at Downstream Pasur, the Sundarbans Bangladesh.” Applied Ecology and Environmental Sciences, vol. 12, no. 1 (2024): 1-6. doi: 10.12691/aees-12-1-1.
435. M. Nur E. Alam, M. Mozammel Hosen, S. R. Khan, M. A. Maksud, A. K. M. Atique Ullah, TR Choudhury, Shamshad B. Quraishi, Assessment of isotopic signature ($\delta^{13}\text{C}$ & $\delta^{15}\text{N}$) in the most undisturbed sediment cores at Sundarbans mangrove area of Bangladesh in studies of sea level rise as well as heavy metal association with the isotopic ratio ($\delta^{13}\text{C}/\delta^{15}\text{N}$), BCSIR Congress-2023, 8-10 March 2024

436. Comparison of Serum Zinc in Children of Wilson Disease and non-Wilsonian Volunteers in Bangladesh *Alam MS, Karim MB, Mazumder MW, Bgum S, Benzamin M. Rahman MH, Hossain MM, Rahman MA, Mondal M, Saha D, Biswas SA, Mymensingh Med J, 2023 Jul; 32 (3): 681-689.
437. Mohammad Anwar Ul Azim, Sanchoy Chandra Biswasarma, Md. Ariful Islam, Md Jashim Uddin, Sanjida Islam, Md Saiful Islam, Fatima Begum, Mustafa Mamun, Shakera Khatun, Md. Alamgir Kabir, Md. Saiful Islam Akand, Hossain, Jasmin Ferdous, Md, Nahid Hossain, Ferdoushi Begum, Shamim Momtaz Ferdousi Begum, Zeenat Zabin, Jasmine Ara Haque, Hosne Ara Rahman, Shakila Zaman Rima, Kamrun Nahar, Murshed Ali, Jharna Das, Nafisa Jahan, Mostofa Shamim Ahsan, Shankar Kumar Dey, Md. Abdul Awal, B K Bose, Faria Nasreen, Sadia sultana, Faridul Alam, Mizanul Hasan, Nurun Nahar, Gazi Abul Hossain, Md. Reajul Islam, Md. Sayeedul Alam, Md. Rakibul Hoque, Ashoke Kumar Paul, Sanowar Hossain, Fouzia Moslem: Newborn Screening for the early detection of congenital hypothyroidism: A countrywide comprehensive program of Bangladesh Atomic Energy Commission. Bangladesh Journal of Nuclear Medicine. Vol. 27 No. 1(2024), pp 81-88. (DOI: <https://doi.org/10.3329/bjnm.v27i1.71515>).
438. Sanchoy Chandra Biswasarma, Mohammad Anwar Ul Azim, Priyanka Poddar, Md Jashim Uddin, Sanjida Islam, Md Saiful Islam, Mustafa Mamun, Shakera Khatun: Prevalence and Determinants of Vitamin D Deficiency: A comprehensive Analysis from the measured Vitamin D level at Chemiluminescence Immunoassay (CLIA) laboratory of National Institute of Nuclear Medicine and Allied Sciences (NINMAS) Dhaka. Bangladesh Journal of Nuclear Medicine. Vol. 27 No. 1(2024), pp 89-94. (DOI: <https://doi.org/10.3329/bjnm.v27i1.71523>).
439. Md Jashim Uddin, Mohammad Anwar Ul Azim, Sanchoy Chandra Biswasarma, Md Saiful Islam, Sanjida Islam, Mustafa Mamun, Ferdoushi Begum, Md, Nahid Hossain, Md. Sohag Mia, Hasan Mehedi, Nur-E-Alam Siddique, Muhtasim Kadir: Radiosynthesis and Quality control of [¹⁸F]PSMA-1007 at the cyclotron facility of National Institute of Nuclear Medicine and Allied Sciences (NINMAS) for diagnosis of prostate cancer. Bangladesh Journal of Nuclear Medicine. Vol. 26 No. 2 (2023), pp 198-200. (DOI: <https://doi.org/10.3329/bjnm.v26i2.71484>).
440. Md Saiful Islam, Mohammad Anwar Ul Azim, Md Jashim Uddin, Sanchoy Chandra Biswasarma, Most. Layla Saroware Banu: Routine Radiochemical Quality control of 99mTc elute and 99mTc-Labeled radiopharmaceuticals. Bangladesh Journal of Nuclear Medicine. Vol. 26 No. 2 (2023), pp 193-197. (DOI: <https://doi.org/10.3329/bjnm.v26i2.71493>).
441. Sanjida Islam, Mohammad Anwar Ul Azim, Md Jashim Uddin, Sanchoy Chandra Biswasarma, Md Saiful Islam, Tapati Mandal, Shakera Khatun, Mustafa Mamun, Md. Saiful Islam, Most. Layla Saroware Banu: Evaluation of the lyophilized MIBI kit fraction for 99mTc labeling: A cost-effective approach for labeling cold kits in nuclear medicine practice. Bangladesh Journal of Nuclear Medicine. Vol. 26 No. 2 (2023), pp 188-192. (DOI: <https://doi.org/10.3329/bjnm.v26i2.71490>).
442. Mohammad Anwar Ul Azim, Synthesis of [18F]PSMA-1007: New Beginning of Prostate Specific radiotracer development in Bangladesh. Bangladesh Journal of Nuclear Medicine. Vol. 27 No. 1(2024), pp 140. (DOI: <https://doi.org/10.3329/bjnm.v27i1.71534>).

XVII. PAPER PRESENTED IN SEMINAR/SYMPOSIUM/CONFERENCE/WORKSHOP

INSTITUTE OF ELECTRONICS

Repair And Maintenance Division,IE

1. SubrataSaha, Md. Shamimul Islam, Md. MahbubAlam, Md. MotinurRahman, Md. ZiaulHasanMajumder, Md. Shah Alam, and M. Khalid Hossain, Bengali Cyberbullying Detection in Social Media Using Machine Learning Algorithms, 5th International Conference on Sustainable Technologies for Industry 5.0 (STI), 09-10 December 2023, Dhaka, Bangladesh (Oral), DOI: 10.1109/STI59863.2023.10464740.
2. Md. Shamimul Islam, SubrataSaha, Md. MahbubAlam, Nayan Kumar Datta, Md. Haidar Ali, Md. MahbubAlam, Md. DulalHossain, and Md. GolamMoazzam, Natural Language Processing and Machine Learning Approaches to Detect Bangla Hate Speech on Social Media, 26th International Conference on Computer and Information Technology (ICCIT), 13-15 Dec. 2023, Cox's Bazar, Bangladesh (Oral), DOI: 10.1109/ICCIT60459.2023.10441452.

3. SubrataSaha; Md. MotinurRahman; TahmidTamrin Suki; Md. MahbubAlam; Md. Shah Alam; and Mohammad Abu SayidHaque, Heart Disease Prediction Using Machine Learning Algorithms: Performance Analysis, 3rd International Conference on Advancement in Electrical and Electronic Engineering (ICAEEE), 25-27 April 2024, Gazipur, Bangladesh (Oral), DOI: 10.1109/ICAEEE62219.2024.10561820.

Solar Cell Fabrication and Research Division

4. M. A. R. Akand, M. K. Basher, S. M. A. A. Zumahi, M. S. Alam and M. A. S. Haque, “Analysis of Etching Impact for High-Efficient Solar Cell Fabrication”, National Conference on Physics for the 21st Century, Hosted by: Physics Discipline, Khulna University, May 18, 2024.

INSTITUTE OF COMPUTER SCIENCE

Nuclear Cyber Security Division.ICS

5. Islam, M.S., Saha, S., Alam, M.M., Datta, N.K., Ali, M.H., Hossain, M.D. and Moazzam, M.G., 2023, December. Natural Language Processing and Machine Learning Approaches to Detect Bangla Hate Speech on Social Media. In 2023 26th International Conference on Computer and Information Technology (ICCIT) (pp. 1-6). IEEE.

6. INSTITUTE OF NUCLEAR MEDICAL PHYSICS

7. Fatema Tuz Zohra, Juwel HosenI,Md Jakir Hosen, Priyanka Podder, Rayhan Alam, Md Abul Hasnat, Rahima Akter Sharmin, Jinia Afrin Khan, Md Rafiqul Islam, M Monjur Ahasan, “First Five Years Performance of FDG PET-CT in Institute of Nuclear Medical Physics”, Bangladesh J. Nuclear Med.: 2024.
8. Ashrafun Nahar Monika, Rajada Khatun, Shirin Akter, Md Abul Hasnat, Md Mahfuzur Rahman, Mohammad Monjur Ahasan. “A Comparison Study of the Solid Phantom and Water Phantom Using 6 MV and 15 MV Photon Energies, Depending on the Depth”, Bangladesh J. Nuclear Med.: 2024.

INSTITUTE OF FOOD AND RADIATION BIOLOGY, AERE

Cytology And Biocontrol Research (CBR), Radiation Entomology And Acarology Division (READ), IFRB

9. Title: Dengue Mosquitoes: Identification, Surveillance and Control Measures. Organized by the Zoological Society of Bangladesh (ZSB) and Department of Zoology, Dhaka University, 17 August 2023, Venue- University of Dhaka, Bangladesh.
10. Title: Workshop on Vector Borne Diseases. Organized by Department of Parasitology, Sylhet Agricultural University, 3 December 2023, Venue- Sylhet Agricultural University, Bangladesh.
11. Title: Karyotype Study of Chironomids (Family: Chironomidae) for Cytotaxonomy and Genotoxicology. Organized by Department of Aquatic Resource Management, Sylhet Agricultural University, 4 December 2023, Venue- Sylhet Agricultural University, Bangladesh.
12. Title: Karyological study of Chironomids (Family- Chironomidae) with relation to ecosystem health in the Surma river, Sylhet, Bangladesh. 23th International Biennial Conference and AGM 2023, 26 April 2024, Zoological Society of Bangladesh.

INSTITUTE OF TISSUE BANKING AND BIOMATERIAL RESEARCH, AERE

13. Polash Chandra Karmakar, Saiful Islam Rayhan, Tusher-Al-Arafat, Md. Hasib Adnan, Marina Khatun, Naznin Akhtar, S. M. Asaduzzaman. The Synergistic Effect of Decellularized Human Amniotic Membrane and Nigella sativa Gel on Burn wound Healing in Rat Model (BCSIR Congress-2023, p-579).
14. Tusher-Al-Arafat, Esrat Jahan Shorna, Polash Chandra Karmakar, Md. Hasib Adnan, Marina Khatun, Naznin Akhtar, S. M. Asaduzzaman. Fabrication and Characterization of Carbon Nanotube Incorporated Hydroxyapatite Based Scaffolds for Bone Tissue Engineering. (BCSIR Congress-2023, p-580).

