

ANNUAL REPORT

July 2022 – June 2023



BANGLADESH ATOMIC ENERGY COMMISSION

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Acronyms

AAS	Atomic Absorption Spectrophotometer
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 Initiatives 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

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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 sciences and nuclear power field have been undertaken in the light of the overall need of the country, so that the outcome of the activities can be directly contributed for socio-economic betterment in food and agriculture, industry, power, health or medicine 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 executed 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 14 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 2022 to June 2023 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.

Program

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:

- Research and Development
- Service
- Thesis supervision
- Paper presentation in seminar/symposium/conference
- Publication
- Attending seminar/symposium/conference/workshop
- Training arrangement
- Collaboration

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

Activities

1. Research And Development Work(s)

Advanced Analytical Chemistry

1.1 Faecal Sludge Management (FSM) through Co-Composting: A Case Study of Mymensingh Municipality, Bangladesh

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

A complete information & analysis of the current status and practices relating to waste creation, collection, disposal, treatment, and the scope of a comprehensive FSM model Bangladesh was unnoticed for many decades. This study aims to assess the quality of faecal sludge and septage management in Mymensingh City Corporation. The pH value in finally treated water decreased. The maximum amount of DO, 1.14 mg/l, was seen in water treated with plants. The elemental composition of faecal sludge and compost in all samples was

determined using X-ray fluorescence (XRF). The most significant potassium (K) and calcium (Ca) average concentrations were identified in faecal sludge 11747.33 ppm, compost 11042 ppm, and faecal treated water 1523.135 ppm. Electrical Conductivity (EC) was also found to be very high. The total organic carbon (TOC) value was 17.21%, within permissible limits. The TON level was 1.754%, within the allowable range. The maximum C/N ratio of the final compost was 9.81:1. Excitation-Emission Matrix (EEM) and Parallel Factor (PARAFAC) analyses identified first component was Photobleached fulvic acid, Autochthonous and Allochthonous and Wavelength 255/404 and 320/403. four fluorophores: Pre-treated (230-345/280-339 nm), With plant treated (260-425/330-423 nm), Bed treated (270-418/320-417 nm), and Final treated (260-431/330-331 nm), and four fluorescent dissolved organic matter (fDOM) components (two Fulvic-like, one Humic, Protein-like, Hydroxy benzoic acid or salicylic acid, , Tryptophan detergent-like) in the faecal water. This study shows that co-composting and faecal sludge are successful management practices suitable for agricultural fields and can be successfully expanded.

1.2 Spatial Distribution of Fluorescent Dissolved Organic Matter (FDOM) and Heavy Metal from Landfill Leachate to The Surrounding Shallow Aquifer

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

Matuail Sanitary Landfill site and Hemayetpur Tannery Industrial Estate Area Waste Site were selected for sample collection station and leachate and water samples were collected from both the study areas on June, 2022. Two raw leachate samples were collected from the open dumping of tannery waste sites. 5 water samples were collected from the nearby household and market area and 13 water samples were collected from the Dhaleshwari river which is exposed to the CETP of the leather industry. Collected samples were analysed for heavy metal using EDXRF. The P^H of both leachates (11.94 ± 0.00) and 10.72 ± 0.04) and lake water (8.75 ± 0.02) was alkaline with the least DO (0, 0, 1.34 mg/L respectively), although groundwater and river water P^H were near neutral with high amounts of DO (6.496 ± 0.04) and (6.26 ± 0.04) mg/L respectively). BOD₅ was reported to be the greatest in Hemayetpur raw leachate (11.12 – 16.32 mg/L) compared to 3.92 – 6.4 mg/L in Matuail raw leachate. According to XRF, the highest concentration of Cu and Cr, $\text{Mn} < \text{Ni}$ and Zn was found in Hemayetpur raw leachate and K was highest in Matuail raw leachate. Rb, Br, and Sr were also present in considerable amounts. Major peaks in the study's data were seen in wave number ranges of 3378 – 3327 cm^{-1} 1650 – 1628 cm^{-1} for Matuail leachate through FT-IR analyses.

1.3 Assessment of Phytoremediation Efficiency of Heavy Metal via *Salvinia cucullata* and *Pistia Stratiotes* to Perform Phytoremediation of Textile Waste Water (influent).

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

The experiment of bioaccumulation was performed in pot culture for a period of 15 – days by using Tilapia fish. The bioaccumulation was evaluated by bioaccumulation factor (BAF) and comparing the results of control culture and the cultures of treatment. BAF of heavy metals in fish fed with contaminated *S. cucullata* biomass showed that Cu ($\text{BAF} > 1$) bioaccumulated significantly. Hg ($\text{BAF} > 0.7$) and Pb ($\text{BAF} > 0.7$) bioaccumulated more than 70%. Fish fed with contaminated *Stratiotes* biomass showed that Cu ($\text{BAF} > 1$) bioaccumulated significantly at lower concentration and heavy metals from the contaminated plant biomass can be significantly bioaccumulated in fish, may affect higher trophic level in food chain accumulated significantly and more than 70% accumulation was found for Pb ($\text{BAF} > 0.7$) and Hg ($\text{BAF} > 0.7$). Implication of finding indicates that *Salvinia cucullata* and *Pista stratiotes* can be used as efficient.

1.4 Identification Carbon Dynamics in Relation to Dissolved Organic Matter (DOM) of Kaptai Lake.

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

Surface water samples were collected 20 cm below the water surface using 10 ml vials rinsed with 5% HNO_3 acid and Mili-Q water to study physicochemical parameter and the diurnal and spatial diversity of FDOM component of Kaptai lake. All samples were collected at a 2-hour interval at the exact location. Samples collected for the Fluorescence spectroscopy was instantly filtered through a succession hand pump using the pre-combusted (4500°C for 4h) 0.45 gm Whatman GF/F glass fiber filters. Immediately the samples were kept at 4°C temperature into a cooler box for 2 days until the samples were transported to the Hydro-biogeochimistry and Pollution Control Laboratory at the Department of Environmental Sciences, Jahangirnagar University. More 24 samples of 1 L were collected using the PET bottles for heavy metal analysis and calculation of DOC and SUVA_{254} from different points of the Kaptai lake.

1.5 Adsorption of Cu(II) and Cd(II) with Graphene-Based Adsorbent: Adsorption Kinetics, Isotherm and Thermodynamic Studies

T. R. Choudhury, Sobur Ahmed*, Mohammad Nurnabi*, M. N. Alam, M. A. Maksud, S. R. Khan, L. N. Lutfu, S. B. Quraishi

Availability and supply of safe water is of great interest for human and other living organisms since the quality of water straight way impacts on them. As a result of fast urbanization and industrialization, sources of water are getting polluted everyday with metals, such as chromium, cadmium, copper, lead, mercury, and the polluted water causes severe crisis to the biological systems. The objectives of this work were to synthesize and apply graphene oxide for adsorption of Cu(II) and Cd(II) from aqueous solutions. The research explored the effectiveness of prepared graphene oxide for removal of copper(II) and cadmium(II) ions with insight studies on the equilibrium, kinetics and thermodynamics of the adsorption processes. In this study, graphene oxide (GO) adsorbent was prepared from commercial graphite powder and characterized using a variety of analytical methods, including X-ray diffraction, X-ray photoelectron spectroscopy, field-emission scanning electron microscopy, Fourier-transform infrared spectroscopy, zeta potential, dynamic light scattering and Brunauer–Emmett–Teller analysis. Batch experiments were conducted to investigate the effect of pH, adsorbent dosage, contact time and metal ions concentrations for adsorptive removal of Cu(II) and Cd(II) ions from aqueous solutions. The kinetics, adsorption isotherms, and thermodynamics were studied to determine the adsorption mechanism. The results showed that at pH higher than 3.5 (pH_{zpc}), carboxyl group of GO was deprotonated to make the surface negatively charged, which was advantageous for metal ions adsorption. It was also evident that the optimum pH for removal of Cu(II) was 5.0, while that of Cd(II) was 7.0. The adsorption processes of Cu(II) and Cd(II) followed both the Langmuir and Freundlich isotherms, indicating complex nature of the adsorption processes. The maximum adsorption capacities (q_{max}) of GO for Cu(II) and Cd(II) calculated from Langmuir isotherms were 193.05 and 231.45 mg/g, respectively. The kinetics studies showed that adsorption processes for both the metal ions followed pseudo-second-order reaction model. Thermodynamic investigations revealed the adsorption process as exothermic and spontaneous at room temperature. Regeneration and reuse of spent adsorbents were also studied and found that regenerated GO demonstrated lower adsorption capacities compared to the fresh GO.

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1.6 Biosynthesized Magnesium oxide Nanoparticles from Tamarindus Indica seed Attenuate Doxorubicin-Induced Cardiotoxicity by Regulating Biochemical Indexes and Linked Genes

T. R. Choudhury, F. Y. Nisa*, M. A. Rahman*, M. N. Alam, M. A. Maksud, S. R. Khan, L. N. Lutfu, and S. B. Quraishi

Nanotechnology based on metal nanoparticles has captured a lot of prominence in recent decades, due to the prospect of great improvements in several physiochemical properties at the nanometer scale. The growth of sustainable products and technologies has risen in recent years in response to considerations over environmental issues, nonrenewable resources, public health, and many others. Hence, experts have been exploring feasible techniques through utilizing natural compounds to boost metal and metal oxide nanoparticle synthesis owing to the toxicity of chemically derived metal-based nanoparticles in the biological system. The phytochemicals of Tamarindus indica seed hydroalcoholic extract were exploited as a biocatalyst for the sustainable synthesis of magnesium oxide nanoparticles (MgO-NPs). This research investigated the cardioprotective effects of biosynthesized magnesium oxide nanoparticle (MgO-NPs). The biosynthesized seed MgONPs were characterized by ultraviolet-visible spectroscopy (UV–Vis), 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 MgO-NPs with a size average of 13.38 ± 0.16 nm. The biogenic MgO-NPs were found to have a significant quantity of total phenolic contents (TPC) and total flavonoid contents (TFC), indicating the existence of phenol and flavonoid-like components. The biogenic MgO-NPs demonstrated a significant free radical scavenging effects compared to different standards as measured by the inhibition of free radicals produced in 2,2-diphenyl-1-picrylhydrazyl (DPPH), 2,2-azino-bis-(3-ethylbenzothiazoline-6-sulfonate) (ABTS), and Nitric oxide (NO) scavenging methods; they also exhibited higher ferric ion reducing capacity in FRAP assay. Moreover, they were found to be non-toxic in cytotoxic assessment. Pretreatment of Wistar Albino rats with seed MgO-NPs resulted in a significant reduction of cardiac biomarkers, i.e., cardiac

Troponin-I (cTnI), creatine kinase (CK-MB), and aspartate aminotransferase (AST). The seed MgO-NPs were more successful in reducing lipid levels. The results of the mRNA expression analysis showed that seed MgO-NPs efficiently reduced the expression of the apoptotic genes p53 and Caspase-3 while restoring the expected levels of SOD gene expression. The histopathological observations were primarily focused on the disruption of cardiac fibers and myofibrillar disintegration, which are consistent with the biochemical findings. Therefore, our research suggests that MgO-NPs derived from the seeds of *Tamarindus indica* as a powerful antioxidant; the administration may be effective in protecting the heart from DOX-induced cardiotoxicity.

* Department of Biochemistry and Molecular Biology, University of Chittagong, Chittagong, Bangladesh

1.7 Development of Polyphenols-Based Nanocomposite Sorbents for Efficient Arsenic Removal from Drinking Water

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

Arsenic contamination of groundwater in Bangladesh has been recognized as a major public problem. The situation in Bangladesh so far is regarded as the biggest environmental arsenic poisoning, with about an estimated 50 million people being at risk of exposure. The overall objectives of this study were to evaluate the feasibility of using of polyphenols based nano adsorbents as an alternate adsorbent for removing arsenite from drinking water. The low-cost sorbent, MPS (metal phenolic sorbent) from physically cross-linked polyphenolic networks using tannic acid and Zr^{IV} ions has been synthesized and investigated it as a replacement for the current expensive methods of removing arsenic from ground water. The sorbent's network-formation process (gelation) has been taken just fifteen minutes to complete at $85^{\circ}C$ without the use of any extra equipment. This system is stable over a wide pH range as evident from the flat spectral lines observed in the UV-visible absorption spectra and thermally stable to higher temperature (Thermogravimetric analyses). From analysis of the scanning electron microscopy (SEM) image the particle size of the MPS ranged from 0.3 to 1.2 μm , and the particles exhibited no macro- and/or microporous structures, suggesting that the sorbents are nanoporous in nature. The sorbent system effectively sequesters Arsenic from aqueous solution which was determined by HG-AAS and ICPMS analysis of the solution after adsorption on the synthesized MPS. Also, the SEM-EDX analysis of MPS after adsorption along with the high-resolution image, identification and quantification of As adsorbed was investigated.

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1.8 Removal of Arsenic from Ground and Waste Water Using Nano-structured Bi-metallic Biochar Synthesized from Biowaste

T. R. Choudhury, M. S Hossin*, M.N Amin*, M. N Alam, M. A. Maksud, S. R. Khan, L. N. Lutfu, S. B. Quraishi

Arsenic is a natural constituent of the upper part of the earth crust and is broadly dispersed all through the environment. Combination of natural process, for example, weathering, erosion, volcanic eruption, as well as through a number of anthropogenic activities mobilize As in the environment. Thus, this study was executed on the efficient removal of As using bio-adsorbent prepared from biological wastes. Bagasse was collected, washed for several time and then dried in an oven at around $105^{\circ}C$. They were pyrolyzed at $500^{\circ}C$ for 2 hours in the furnace. The obtained biochar was taken out of the furnace when it was conveniently cooled and then grinded using mortar and pestle. Following that, to chemically activate the biochar, 0.46g of it was taken and mixed with $KMnO_4$ and $Al_2(SO_4)_3 \cdot 18H_2O$. The mixture was then stirred for 2 hours and filtered in a vacuum filter. The filter cake obtained was oven dried for 2 hours. After that, chemical activation was done at $700^{\circ}C$ for 1 hour. A total of 0.89g of activated carbon was obtained from 1.37g biochar of bagasse in this way. The adsorption analysis was conducted in an adsorption column placing the adsorbent in the bottom of it. Pouring the arsenic solution of definite concentration and pH, the solution was allowed to flow through at a definite flow rate. 0.02g, 0.04g, 0.07g and 0.11g of the adsorbent was taken in four different columns and 80mL of 500ppb As solution with pH 3.5 was run through each of the column. Increasing amount of the adsorbent gave higher percentage recovery of As with the highest recovery of 86.1% corresponding to 0.11g of the activated carbon. Also, analysis was done varying the pH of the As solution. pH of 2, 4, 7 and 9 was passed through 0.05g of the adsorbent each in four different columns. High adsorption capacity was observed for the lower pH value. In this way, conducting the analysis for efficient removal of arsenic from ground and wastewater, 0.05g of the

Bagasse-Mn-Al adsorbent can recover around 90% of arsenic from the solution at pH 2 within 1 hour. This amount of recovery using such a cheap activated carbon in such short period of time is very promising.

*Department of Applied Chemistry and Chemical Engineering, University of Dhaka.

1.9 Removal of Chromium from Waste Water by Using Bi metal Impregnated Activated Carbon from Coconut Shell

T. R. Choudhury, M. M. Rahman*, M.N Amin*, M. N Alam, M. A. Maksud, S. R. Khan, L. N. Lutfi, S. B. Quraishi

The presence of chromium in wastewater poses significant environmental and health concerns due to its toxicity and non-biodegradable nature. This thesis aimed to provide a comprehensive investigation into various effective methods for the removal of chromium from wastewater using bi-metal impregnated activated carbon. In this study, activated carbon was prepared from coconut shell and charcoal was prepared. Following that for activation of charcoal FeSO_4 and CuSO_4 were added. The pore properties including the BET surface area, pore volume, pore size distribution and average pore diameter were characterized. The removal of Cr(VI) from aqueous solutions by adsorption has been studied. The effects of pH, contact time and temperature on adsorption of Cr(VI) were investigated. The maximum adsorption yield was obtained at the initial pH of 3.84. The absorption kinetics shows that pseudo-second order rate expression fitted the adsorption kinetics. Equilibrium isotherms were measured experimentally. Results were analyzed by the Langmuir, Freundlich, Dubinin-Redushkevich, equations using linearized correlation coefficient at different temperatures. The characteristics parameters for each isotherm have been determined. Models and isotherm constants were evaluated depending on temperature. Langmuir equation was found to fit the equilibrium data for Cr(VI) adsorption. The study is in progress.

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1.10 Preparation and Characterization of ZnO Nanoparticles

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

Having magnetic character, inherent antimicrobial, anticancer properties and Reactive Oxygen Species (ROS) generation capability ZnO Nano-particles mostly used in biomedicine. It is also used into sunscreen agents as it possesses ultraviolet (UV)-absorbing characteristics and visible light transparency. Extensive research conducted to investigate new characteristics and properties of ZnO Nano-particles. Our study goal is to prepare Zinc Oxide nanoparticles and reveal its latent characteristics. The extent of the successful preparation of the quartzite structure and its characteristics are studied with UV-Visible Spectroscopy, X-ray diffraction (XRD), Energy dispersive X-ray (EDX) and Transmission electron microscopy (TEM). We synthesized Zinc oxide (ZnO) nanoparticles (NPs) by precipitation method using ammonia. 15.37gm of Zinc Acetate salt was taken in a 500 mL volumetric flask and dissolved in 200 mL DI water. The solution then transferred to a 500mL beaker and constantly heated on a heating mantle at 80°C with constant stirring. About 25mL of concentrated ammonia added drop wise to the solution until the reaction completed. Curdy white coloration of the solution indicates the completion of the reaction. The mixture then filtered and dried in an oven at 120°C for 8.0 hours. Then the product was calcified in a furnace at 200°C , 300°C , 400°C and 500°C for 5.0 hours. The product then crushed and subjected to several investigation process for its characterization. UV-visible spectroscopy was used in the wavelength range 200-800nm for band gap and optical characterization, XRD, TEM and EDX done for structural determination and VSM has carried out for the study of the magnetic behavior. All the investigations demonstrate the successful preparation of ZnO Nano-particles, completing the analysis of the results of the investigations a complete manuscript is ready for the publication in an international journal.

1.11 Preparation of Mn-doped ZnO Nanoparticles and Assess the Effect of Doping on the Structural and Magnetic Properties of ZnO Nanoparticles

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

Doping of Mn enhance the optical, magnetic, and electrical properties of ZnO by influencing the physical, chemical, and structural properties of ZnO nano-particles. Doping induces important modification to the ZnO

nano-Particles gives it a potential for use in spintronics, optoelectronics and in biomedicines. Our study goal is to reveal the effects of doping in properties of ZnO nano-particles by a simple co-precipitation method of Mn doped ZnO nano-particles. For the co-precipitation method 15.37gm of Zinc Acetate, $\text{Zn}(\text{CH}_3\text{COO})_2$ taken in a 500 mL volumetric flask and dissolved in 200 mL DI water. 0.166gm MnCl_2 pre-courser taken in another 100 mL volumetric flask and dissolved. The two solutions then mixed into a 500mL beaker and constantly heated on a heating mantle at 80° C with constant stirring. 25mL of concentrated ammonia drop wise added to the solution until the reaction completed. Curdy white coloration of the solution indicates the completion of the reaction. The mixture then filtered and dried in an oven at 120°C for 8.0 hours. Then the product was calcified in a furnace at 200°C, 300°C, 400°C and 500°C for 5.0 hours. The product then crushed and subjected to several investigation process for its characterization. UV-visible spectroscopy has done at 379 nm wavelength for band gap and optical characterization, XRD, TEM and EDX done for structural determination an VSM has carried out for the study of the magnetic behavior. The result of all the investigations indicate the successful preparation of Mn doped ZnO Nano-particles.

1.12 Doping of ZnO Nanoparticles with Cobalt (Co^{+2}) to Study the Changes in Ferromagnetic Properties

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

Containing ferromagnetic property Dilute magnetic semiconductors (DMS) are getting great attraction of the researchers for use in spintronic devices. Practical applications DMS possess very low Ferromagnetic Curie temperatures compared to the other semiconductors. In Co doped DMS the intrinsic defects of ZnO nanoparticles are altered and helps to enhance magnetic properties to use it in spintronics as well as for gas sensing applications. In this study we report the doping effect of ZnO nanoparticles with Co on the structural, morphologies and changes in certain Ferromagnetic properties. Undoped ZnO and Co-doped ZnO (3.5wt%) were synthesized by the co-precipitation method. For the synthesis we were used Zinc acetate (99%), Cobalt chloride (98%) and ammonium solution. The prepared solutions of Zinc acetate and Cobalt chloride were mixed into a 500mL beaker and constantly heated on a heating mantle at 80° C with constant stirring. 25mL of concentrated ammonia drop wise added to the solution until the reaction completed. Curdy white coloration of the solution indicates the completion of the reaction. The mixture then filtered and dried in an oven at 120°C for 8.0 hours. Then the product was calcified in a furnace at 400°C for 5.0 hours. The product then crushed and subjected to several investigation processes for its characterization. UV-visible spectroscopy has done at 381nm wavelengths for band gap and optical characterization. For structural determination XRD, TEM and EDX has done. To study of the magnetic behavior VSM has carried out.

1.13 Preparation of Fabricated ZnO Nanoparticles Doping with Fe to Study the Changes in Structural, Morphological and Magnetic Property of Fe-doped ZnO

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

ZnO is a n-type semiconductor, with a wide band gap energy (E_g 3.37 eV), and a large exciton binding energy, 60 meV. Transition metal ions such as Cu^{2+} , Co^{2+} , and Fe^{3+} have been used as dopants for ZnO, with the objective of modifying some of their properties. In doping the Fe^{3+} substitutes the Zn^{+2} state in crystal networks and affect the properties of the surface, optical, electrical and magnetic properties strongly. In this research Fe-doped ZnO nanostructures have prepared via chemical route synthesis with co-precipitation method to study and the changes in Structural, Morphological and Magnetic properties. Co-precipitation synthesis method were applied for the synthesis of Fe-doped ZnO nanoparticles. In this method we used Zn: Fe (96.5:3.5 atm%). $\text{Zn}(\text{CH}_3\text{COO})_2 \cdot 2\text{H}_2\text{O}$ and $\text{FeSO}_4 \cdot 4\text{H}_2\text{O}$ solution were made with DI water then mixed with pre-courser. The solution then transferred to a 500mL beaker and constantly heated on a heating mantle at 80° C with constant stirring. 25mL of concentrated ammonia drop wise added to the solution until the reaction completed. Curdy violet coloration of the solution indicates the completion of the reaction. After completing the reaction, the solution was filtered and dried in an oven at 120°C for 8.0 hours. Then the product was calcified in a furnace at 400°C for 5.0 hours. The product then crushed and stored for further investigations.

1.14 A Facile Synthetic Route of Some Drug-like Molecules and Their Potential as DPP-IV Inhibitors

Md Shohel Rana

Treating diabetes by targeting the amino peptidase, dipeptidyl peptidase 4 (DPP4) has become an attractive therapeutic option for treating Type 2 diabetes Mellitus (T2DM). we hypothesize that drug-like molecules with sulfamide, sulfumidate and sulfurofluoridoimide scaffolds could be effectively made by exploiting SuFEx click chemistry that may be tested as DPP4 inhibitors. Compounds containing S(VI)-F moieties like iminosulfur oxydifluoride ($-N=SOF_2$) and fluorosulfate($-OSO_2F$) motif on the pyridine ring would be made that can be used as a coupling partner in transition metal-mediated coupling chemistry or can be used in further SuFEx chemistry to achieve our final small molecule mini library. We further hypothesize to guide the design of these novel molecules using structure-based drug design tools such as molecular docking and molecular dynamics. Four different molecules (MSR1-MSR4) have been proposed as DPP4 inhibitors. The retrosynthetic analysis has been carried out and the synthetic design has been made accordingly using available click chemistry approach. Theoretical ADMET parameters have been checked to verify drug-like properties of the molecules. Also, molecular docking approach has been studied for the all proposed drug-like molecules against DPP4 enzyme. Currently, molecular dynamic simulation is being carried out. After studying the MD simulation, we can further move towards synthetic approaches to verify the synthetic route.

1.15 Synthesis of Silver Nanoparticles (AgNPs) Using *Momordica Charantia* Extracts to Perceive the Feasibility of its Application as Medicinal Agent in Different Purposes

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

Extracts from Plants can be considered as one of the best sources of natural surfactants for the preparation of nanoparticles in a greener way. Having a unique intrinsic properties *Momordica charantia* has been considered as supplier of promising medicinal material and been using in ancient traditional medicine from long ago. In this context we synthesized silver nanoparticles (AgNPs) using *Momordica charantia* extract, and their physicochemical properties were investigated. Our research goal is to synthesize silver nanoparticles (AgNPs) using *Momordica charantia* a greener and cost-effective process and characterize it to realize the feasibility of its application as a medicinal agent in different medical field. Being eco-friendly, nonhazardous and having cost effectiveness advancement over physical and chemical methods, green methods are safe, one step, and simple and did not require any chemical reducing and stabilizing agents. *Momordica charantia* were collected from five different location of the Dhaka district for the synthesis of AgNPs. The leaf was washed by deionized water for here times. Clean leaves were dried in at sunlight and then crushed as leaf fine powder using mortar and pestle. 5.0 g fine leaf powder was added to 200 mL deionized water and then heated to 80°C for 30 minutes. The mixture was stirred continuously with a stirrer and hot plate during heating to keep the mixture uniform so that the maximum collision between water and leaves powder to ensure maximum extraction of phytochemicals. After cooling the mixture was filtered, then leaves extract was added dropwise to 500mL of 15mM $AgNO_3$ solution at 80°C. The addition was done until the color of the mixture turned to reddish black. The mixture was kept for 24 hours for sedimentation, then the sample was centrifuged for 30 minutes with 4000 rpm speed. The centrifuged sample washed for 4-5 times for proper cleaning of nanoparticles. The sample then dried at 120°C and crushed using mortar and pestle to make fine powder. The powder stored in a clean vial for further characterization. The characterization of the synthesized Ag NPs was carried out using various techniques such as UV-visible (UV-Vis) spectroscopy, energy dispersive X-ray (EDX) spectroscopy, Fourier transform infrared (FT-IR) spectroscopy, transmission electron microscopy (TEM) analyses, confirmed the successful generation of silver nanoparticles (AgNPs).

1.16 Synthesis of $ZnO_2/MnO_2@TiO_2$ Porous Nanomaterials Synthesis for the Efficient Removal of Radionuclide from Aqueous Solution

M. Nur E Alam and Shamshad B Quraishi

The construction of a nuclear power plant in Bangladesh will mark a significant advance in the peaceful use of nuclear energy and the reduction of carbon emissions from the electricity industry. Additionally, it is giving science and technology education and research in our nation a new dimension. The primary goal of this initiative is safety, which involves shielding people and the environment from radiation and harmful substances. Therefore, safe management of poisonous and radioactive materials at nuclear facilities is of the utmost importance everywhere. Therefore, it is crucial to understand the analysis and management of such

massive quantities of radioactive and poisonous elements. Nanomaterial based novel materials on organic-inorganic framework with highest efficient removal capacity of toxic and radioactive materials. We have designed four novel organic-inorganic framework based nanomaterial using software for their best fit to separate toxic and radioactive materials from a simulated solution. Then the best fit nanomaterials were taken into account to laboratory synthesis. The best fitted nanomaterial will take for necessary modification and characterization. The well-prepared novel nanomaterials will subject to simulated solution with maintaining pH, temperature, contact time and concentration of waste part. The solution will selectively participate in adsorption/coprecipitation and then analyze the solution for separation efficiency. Finally submit the best fit nanomaterials expected with highest efficient, highly selective for toxic and radioactive element removal.

Food Chemistry

1.17 Exposure of Heavy Metals via dietary Intake of Some Commonly Consumed Marine Fishes Collected from the Shitakunda Ship Breaking Areas of Bangladesh

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

Present experiment enlightened on the determination of the level of some heavy metals (i.e., Cr, Cu, Pb, Mn, Hg, Sn and As) in fish samples collected from Shitakunda ship breaking area and evaluating exposure level of health hazards of HMs in both children and adults due to consuming contaminated fishes, calculation of various indices using multivariate techniques with the special emphasis on possible sources apportionment of HMs. Concentration of heavy metals in all the analyzed fish species from the study sites were generally low and safe for human consumption. Non-carcinogenic index (THQ) and carcinogenic risk index (TR) values indicated that there was no risk from consumption of studied fish samples.

1.18 Heavy Metal Accumulation in Fish via Consumption of Contaminated Plant Biomass

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

The experiment of phytoremediation was designed in batch culture for a period of 14-days. The uptake efficiencies of Cu, Hg, Pb, Rb, Zn, Sr and Mn by using the culture of *Salvinia cucullata* in 15% wastewater treatment were 99.64%, 99.19%, 82.28%, 58.67%, 32.32%, 15.54%, and 9.67% respectively. In 25% wastewater treatment, the uptake efficiencies of Cu, Hg, Pb, Rb, Zn, Sr and Mn were 99.50%, 99.14%, 81.80%, 24.58%, 8.50%, 9.96% and 25.99% respectively. The uptake efficiencies of Cu, Hg, Pb, Rb, Zn, Sr and Mn in the culture of *Pistia stratiotes* in 15% wastewater treatment were 99.48%, 91.47%, 98.11%, 55.44%, 45.19%, 46.08% and 8.51% respectively.

1.19 Assessment of Heavy Metal Concentration in Bighead Carp Fish with Supplementary Feeds in Bangladesh Region and their Impact on Human Health

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

The bighead fish were collected from ponds located in the farmlands of Noakhali, Bangladesh and fish feed was collected from the local market, to examine the presence of heavy metal in fish feed, and edible tissues of bighead carp fish and potential risk on human health. Each pond was chosen based on its accessibility and similarity in features such as water depth, pH levels, dissolved oxygen concentrations, and organic matter content. The hierarchy of mean heavy metal concentration were $Ca > Fe > Zn > Cu > Mn > Sr > Se > Rb > Cr > Hg > Pb > Co > As$ in feed and $Ca > Fe > Zn > Cu > Sr > Se > Mn > Rb > Cr > Co > Hg > Pb$ in Fish sample analysed. Target hazard quotient $THQ < 1$ for both the age group was estimated based on the studied heavy metals, more over carcinogenic risk also stipulated safe for both the population group. Contamination source was apportioned mainly anthropogenic.

1.20 Evaluation of Heavy Metals in Vegetable Samples Collected from Karnaphuli River and Their Possible Health Risks Assessment.

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

Vegetable samples were collected from the Karnaphuli River estuary for heavy metal analyses using EDXRF technique. To determine the pollution status in the vegetable samples the heavy metals (Mn, Fe, Cr, Cu, Ni, As, Zn, Sr and Pb) analysis were done various pollution indices like Health risk Index and Ecological Risk assessment were done, moreover exposure to heavy metal via inhalation, ingestion and dermal contact were also estimate to evaluate contaminated samples exposure to human health. Furthermore, health risk effect due to dieter consumption of vegetable samples for human health was also evaluated. The work is in progress.

1.21 Heavy Metals Accumulation in Tissues of Wild and Farmed Barramundi from the Northern Bay of Bengal Coast, and Its Estimated Human Health Risks

T. R. Choudhury, T. Tahiti*, M.B. Hossain*, M. N. Alam, M. A. Maksud, S. R. Khan, L. N. Lutfa, S. B. Quraishi

Globally, both natural water bodies and aquaculture systems are being severely contaminated by heavy metals due to rising anthropogenic activities. Fish living in aquatic environments can easily accumulate metals in their bodies, which can then be transferred to consumers and put them at risk. This study aimed to evaluate metal concentrations (Pb, Cd, Cr, As, Mn, Cu, Zn) in different organs (gill, liver, and muscle) of farmed and wild Barramundi (*Lates calcarifer*) fish from the northern Bay of Bengal to quantify and compare contamination levels and related human health risk. Heavy metal concentrations were higher in liver tissues of farmed Barramundi than in wild Barramundi, with the following relative mean values in the liver, gills, and muscle: Zn > Cu > Pb > Mn > Cd > Cr > As; Zn > Cr > Cu > Pb > Mn > Cd > As; Zn > Pb > Cu > Cr > Mn > Cd > As; Zn > Pb > Cu > Cr > Mn > Cd > As; and Zn > Pb > Cu > Cr > Mn > Cd > As, respectively. The differences in heavy metal accumulation observed between farmed and wild fish were probably related to the differences in their environmental conditions and dietary element concentrations. However, ANOVA indicated that the variation of metals in wild and Barramundi was not statically significant. Pb concentrations in the liver tissue of farmed Barramundi exceeded the national and international threshold limits, whereas concentrations of other metals were within the limit. Among the examined organs in both fish species (wild and farmed), muscle had the lowest concentration compared to others, and liver was the target organ for Pb, Cu, and Cd accumulations. Metals such as Zn and Mn exhibited higher concentration in the gills. However, all the studied heavy metals were below the maximum permissible limits of national and international standards, but the mean concentrations of Pb and Cd values in the liver of farmed Barramundi exceeded all international and national guidelines. Based on the contamination factors (CF) and pollution indices (PLI and MPI), the degree of contamination in the fish organs was as follows: gills > liver > muscle. The major accumulation tissues for both farmed and wild fish were found to be the gills (MPI = 0.970) and the liver (MPI = 0.692). Based on the estimated daily intake (EDI), the fish samples examined in this study are safe for human consumption as within the recommended daily allowance (RDA) range established by various authorities. According to the Target Hazard Quotient (THQ) and Carcinogenic Risk (CR) calculations, though the Barramundi fishes depicted no potential hazard to humans, farmed fish posed a higher health risk than wild fish.

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1.22 Arbuscular Mycorrhizal Fungi Enhance Biomass Growth, Mineral Content, and Antioxidant Activity in Tomato Plants under Drought Stress

T. R. Choudhury, Mohammad Zahangeer Alam*, M. N. Alam, M. A. Maksud, S. R. Khan, L. N. Lutfa, S. B. Quraishi

Arbuscular mycorrhizal fungi (AMF) are beneficial microbes forming a symbiotic relationship with food crops. AMF are symbiotically associated with crops. They increase biomass production, nutritional elements, and antioxidant activities in food and vegetable crops grown in soil under stress conditions. The present study focused on the effects of AMF (*Acaulospora morrowiae*, *Paraglomus occultum*, *Funneliformis mosseae*, *Rhizophagus clarus*, and *Rhizophagus intraradices*) on biomass growth and yield, contents of chlorophyll and carotenoids, activities of catalase (CAT) and ascorbate peroxidase (APX), and contents of hydrogen peroxide (H₂O₂), malondialdehyde (MDA), and minerals (Na, K, Ca, Mg, and Fe) in Unnayan, LT896, and Minto super tomato (*Solanum lycopersicum* L.) varieties grown in soil under drought stress. The results showed that root length and shoot mass in plants treated with *R. clarus* and *P. occultum* were significantly higher than those of the control (non-AMF) in Minto super tomato. Compared to the control, the shoot's dry weight and yield were enhanced by 28% and 20% with AMF-treated tomatoes. The CAT activity in *P. occultum*-treated plants was statistically higher than that of the control in Unnayan tomatoes. H₂O₂ content was detected higher in the control than *R. clarus*-treated LT896 tomatoes. In plants treated with *A. morrowiae* and *R. clarus*, APX activity was significantly higher than that of the control in the Unnayan tomatoes. CAT and APX activity increased by 42% and 66% in AMF-treated leaves of tomatoes compared to non-AMF. Treatment with AMF reduced the content of MDA and H₂O₂ (ROS) in the leaves of tomato plants by 50% and 2% compared to the control, respectively. Potassium (K), calcium (Ca), magnesium (Mg), and iron (Fe) of tomato fruits increased by 2%, 13%, 24%, and 37% with AMF treatment compared to the control. These results suggested that biomass

growth, yield, photosynthetic pigments, antioxidant enzyme activity, and mineral contents could be enhanced by AMF in food crops grown under drought stress. It is concluded that AMF might be used for the development of AMF-enriched biofertilizers that will improve the nutritional quality of food crops grown under stress conditions.

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1.23 Microplastic Contamination in Processed and Unprocessed Sea Salts from a Developing Country and Potential Risk Assessment

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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, characteristics and potential risks of MPs. The quantities of MPs in unprocessed salts (average 195 ± 56 item/kg) were higher than those in the processed salts (average 157 ± 34 item/kg). One-way analysis of variance (ANOVA) showed significant ($p < 0.05$) differences among the average numbers of MPs in both processed and unprocessed salts. MP levels in this were 2–3 times higher than those reported from some other countries. Fiber-shaped and transparent MPs were dominant in both cases. MPs less than 0.5 mm in size were the most abundant in both unprocessed (58.2%) and processed (62.2%) salts. Fourier-transform infrared spectroscopy (FTIR) analysis confirmed five types of polymers, including polyethylene terephthalate (PET– 35%), polypropylene (PP– 27.5%), polyethylene (PE– 25%), polystyrene (PS– 10%), and Nylon (2.5%) in the studied salts. The sea salts were classified as potential hazard index (PHI) levels IV to V, indicating serious MP contamination, whereas potential ecological risk factor (Ei), potential ecological risk index (RI), and pollutant load index (PLI) indicated moderate levels of pollution of MPs. Domestic and municipal wastewater effluents to Bay of Bengal and fishing activities may attributed to presence of MPs in the sea salt. These findings can be used by consumers, salt industries and policy makers to reduce MPs levels during consumption, production and policy making.

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1.24 Arsenic in The Foodstuffs: Potential Health Appraisals in a Developing Country, Bangladesh

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

The presence of highly poisonous arsenic (As) elements in food concerns humans and animals. In Bangladesh, arsenic-contaminated groundwater is frequently utilized for agricultural irrigation. This is a significant source of arsenic pollution in the human food chain. For the first time, we investigated the presence of total arsenic in various foodstuffs obtained from 30 distinct agricultural eco-zones of Bangladesh to understand human exposure to arsenic through the food chain in Bangladesh. The greatest and lowest As concentrations were reported in fish among the examined dietary items (0.55 mg/kg, fw) and fruit (0.0068 mg/kg, fw), respectively. The results show that arsenic consumption from daily diet and food with drinking water was estimated to be 0.0352 mg/day for rural residents and 0.2002 mg/day for urban residents, respectively. The highest target hazard quotients (THQ) of arsenic in the fish samples surpassed the allowable limit (>1), proving that fish are the primary dietary items influencing the possible danger to health. However, the target cancer risk (TR) from nutritional arsenic consumption was likewise higher than tolerable. A value of 10–4 indicates that Bangladeshi people are continuously exposed to arsenic, which has carcinogenic and non-carcinogenic dangers. Overall, our results highlight that people in Bangladesh are exposed to hazardous levels of arsenic throughout the food chain, which should be addressed to ensure the country's food safety.

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Atmospheric and Environmental Chemistry**1.25 The Vulnerability of Coastal Landscapes and Ecosystems to Sea-Level Rise and Climate Change (RCA)**

S. B. Quraishi, T. R. Choudhury, M. N. Alam, M. M. Hosen, M. A. Maksud, S. R. Khan, L. N. Lutfu and IAEA*

To assess the vulnerability of the coastal landscape and ecosystem due to sea level rise that is being caused by climate change. The aim of the project is to assess the rate of sea level rise with climate change and possible impact on the shoreline ecosystem. Four Sediment core along with water and leaves from different point of Sundarban had been collected. The sediment cores had been carefully sliced into 32 slices, separated and dried. One portion of the dried sediment had been sent IAEA affiliated laboratory at Australia for relevant analysis while the rest have checked for organic content, moisture content, heavy metals. The water had been tested for various physiochemical parameters and for the presence of the heavy metals. The leaves had been analysed for metal content. All analyses have been completed and final report has been sent to IAEA. A scientific article will be published on this work.

*International Atomic Energy Agency (IAEA)

1.26 Study on the Bioaccumulation of Heavy Metals in the Core Sediment and Tree Roots of Kholpetua and Chuna River, Munshiganj, Shaymnagar, Satkhira

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Mangroves bear enormous ecosystem value, while the ecosystems are facing increasing environmental pressures due to coastal aquaculture development and industrial expansion. So, the study was conducted in the mangrove forest of Shaymnagar upazila of Shatkhira district to assess the heavy metal pollution in core sediments and roots of the tree to assess the ecological risk. Four core samples (1-30 cm vertical profiling) and six tree roots were studied. In this study, 30 samples of sediments and plant roots were collected from the mangrove area of the Satkhira region in Bangladesh. Vertical profile of the core does not show major variation but according to USEPA trace metals of Pb, Zn, Cu, Ni and Cr exceed guideline toxicity reference value at 25%, 4%, 100%, 100% and 79% respectively. According to WHO/FAO, Pb, Cd, Cr exceed the guideline limit for all the sampling location and Cu exceed at spot-2, spot-4 and spot-5. According to WHO (1996), Ni exceed at the spot-1. Pearson correlation was also done for root where Cu showed strong positive correlation with Pb ($r = 1.000$); Co showed strong correlation with Fe ($r = 0.886$) at 0.01 level which means Cu increases with Pb and Co increases with Fe in a significant way. According to core sediment indexing, the Igeo values indicated no contamination for all the trace metals except Cd and Cr which indicated heavily and extremely contaminated sediment. Contamination factor (C_f) for Pb showed the moderate contamination degree where C_f values calculated within the range $1 < C_f < 3$. All the depths of core sediment for Zn show moderate contamination but the depth of 6 c.m in core-1 shows low contamination. PLI indicated low degree of pollution except the depth of 2 c.m. and 6 c.m. of core-4 which shows no degree of pollution. Ecological risk (Er) values indicated slightly polluted for all the core sediments. Most of the PERI values indicated low risk for all sampling spots. Bio-concentration factor (BCF) for Pb, Zn, Cu, Mn, Ni, Cr, Cd, Fe and Co are greater than 1 shows potential success of phytoremediation. According to BCF *Avicennia alba* shows much phytoremediation than *Sonneratia apetala* in most of the sampling locations. This study demonstrates that the current status of sediment quality in mangrove sediment at the study area is relatively good and the pollution level is relatively low except some trace metals which are needed to point out for maintaining healthy ecosystem for coastal region.

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1.27 Investigation of Sources and Distribution of Heavy Metals in Water and Plant Leaves from the Kholpetua and Chuna River in Mangrove Forest, Satkhira, Bangladesh

S. B. Quraishi, M. A. Baki*, A. Sarker*, T. R. Choudhury, M. N. Alam, M. M. Hosen, M. A. Maksud, S. R. Khan, L. N. Lutfu and M. Akter*

Mangrove habitats are unique in many ways, such as the cycle of carbon and nutrients, the properties of the sediment, and the tidal conditions, all of which are anticipated to have an impact on speciation and

consequently the bioavailability of pollutants. The study was conducted in the mangrove forest of Shyamnagar upazila of Satkhira district to assess the heavy metal pollution in water and four selected mangrove plant leaves. The concentration of two trace metals (Pb and Cu) out of nine in water samples were higher than toxicity reference value admitted by USEPA (1999) for both fresh and marine water. The elevated level of trace metals could ultimately contaminate the aquatic biota like fish, crab etc. The concentration of Pb in leaves of *Avicennia alba* (Bain), *Excoecaria agallocha* (Geoa), *Heritiera fomes* (Sundari) and the concentration of Cd in almost all selected plants leaves exceeded the permissible limit set by WHO (2007) which could be detrimental for living biota depending on it and mangrove environment. The water indices (HPI, HEI, CD, NI) indicated that sampling sites pose moderate or low ecological risk. The Pearson Correlation matrix of water sample showed positive correlation between parameters (Pb with Mn and Ni, Cd with Zn) that indicates these parameters might have been originated from same source as they show significant positive correlation ($p < 0.01$). Based on the results of the study, the water and plants of the Kholpetua and Chuna River have exposed by heavy metals significantly. Consequently, monitoring thoroughly to find out the source of heavy metals in this area is recommended.

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1.28 Assessment of Heavy Metal Contamination in the Water across the Passur river of the Sundarbans Mangrove Forest

S. B. Quraishi, S. Begum*, T. R. Choudhury, M. N. Alam, M. M. Hosen, M. A. Maksud, S. R. Khan, L. N. Lutfu

With the aggression of heavy metal contamination commonly through water way and having the Passur river running through the forest, it is important to check the different components of the river system. Thus, this work was aimed to check the level of heavy metals currently present in water of the river at different points within the forest. Concentrations of Pb, Cd, Cr, As, and Hg and physical parameters were determined in water samples by Atomic Absorption Spectrophotometer (AAS) and other techniques. Results indicated that, all the metals in water were found below the maximum allowable concentration limit of WHO (1993). From this research it can be said that, the waterbodies of the Passur river (*Harbaria*) of the Sundarbans ecosystem are not contaminated with heavy metal still now. Therefore, to assess the pollution level, we need depth wise water data considering high tide/ low tide/ at different seasons. This study can serve as a baseline for sustainable environmental management.

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1.29 Vulnerability Assessment of Mangrove Ecosystem of the Sundarbans Mangrove Forest to Metallic Contamination

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Sundarban is the world's largest naturally grown mangrove forest. It has a unique environment supporting and harboring a huge number of animals and plants including endangered ones. With the aggression of heavy metal contamination commonly through water way and having the Passur river running through the forest, it is important to check the different components of the river system. This study investigated the levels of metals in seafood, water and sediment from Passur river in Mangrove forest, an area vulnerable to environmental pollution. Six sediment core, six water and one fish samples have been collected from 6 stations and they have been prepared for analysis. Target analytes include Pb, Cd, Cr, As, Hg, Ni, Cu, Zn etc. Samples were analyzed for metals using the atomic absorption spectrometer. Then, Ecological Risk Assessment (ERA) and Human Health Risk Assessment (HHRA) were evaluated. The highest Contamination Factor (CF) and highest Ecological Risk index (ERi) were observed for Cd. The Estimated Daily Intake of As, Cd, Cr and Pb from consumption of seafood were higher than the permissible levels. Taken together the metal burden of Passur River may pose both human and ecological risk.

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1.30 Risk Assessment due to Metallic Contamination of Fishes of the Passur River along the Sundarbans Mangrove Forest

S. B. Quraishi, S. Begum*, T. R. Choudhury, A. K. M. A. Ullah, M. N. Alam, M. M. Hosen, M. A. Maksud, S. R. Khan, L. N. Lutfa, S.T.Uuzzaman* .

Sundarban is the world's largest naturally grown mangrove forest. It has a unique environment supporting and harboring a huge number of animals and plants including endangered ones. With the aggression of heavy metal contamination commonly through water way and having the Passur river running through the forest, it is important to check the different components of the river system. The aim of this study was to assess the fish quality with regard to concentrations of the potentially trace elements mercury(Hg), lead(Pb), cadmium(Cd), arsenic (As), chromium (Cr), copper(Cu), iron(Fe), and zinc(Zn) in Rita and Tuna fishes collected from the Passur river at different points within the forest. The present study on heavy metal contamination in Rita and Tuna fishes have been carried out to check contamination level and to assess the risk due to consumption for the Bangladeshi people. Trace-metals were determined using the AAS after a microwave-assisted digestion process. A significantly high amount of non-essential toxic metals Pb, Cd, As and Hg (mg/kg, wet-weight) were found in samples. 90% of examined fish samples exceeded the permissible levels for Pb according to Bangladesh and international limit. However, for other trace-elements, these fishes pose no threat to Bangladeshi adults. This was indicated by quality indices (THQ and HI) showed below one and the cancer risk factor within the range. However, due to the reported significant amounts of nonessential metals exceeded in samples, a continuous monitoring process is required.

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1.31 Assessment of Human Health and Ecological Risks of Heavy Metals in Agricultural Soil and Foods of Industrial Zone of Dhaka District, Bangladesh.

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In recent times, vegetable fields are significantly affected by heavy metal damages from various polluted sources including industrial waste, traffic, pesticides, herbicides and so on. The present study evaluates the concentration of heavy metals in three different vegetables species around industrial area of Dhaka city Bangladesh along with their respective sample. The study is conducting to assess the potential ecological and human health risk of toxic metals in agricultural soils and vegetables near the industrial areas of Dhaka district, Bangladesh. In this study, nine toxic metals (Pb, Cr, Cd, Hg, As, Mn, Ni, Cu, and Zn) are assessed in 18 vegetable samples and 18 soil samples of eighteen different sampling sites around the three industrial areas of Dhaka districts in Bangladesh. Toxic metals are measured using atomic absorption spectrometer. The pollution and health risks of the metals assessed with commonly used indicators. Potential ecological and human health risk assessed through enrichment factor (EF), contamination factor (C_f), geo accumulation index (I_{geo}), pollution load index (PLI), toxic unit analysis, chronic daily intake through exposure pathway, hazard quotient, and hazard index. Environmental Pollution indices revealed that, the study areas were mostly contaminated with Ni ($I_{geo} > 1$ and $3 < C_f$ and $C_f \geq 6$). Also, the analysis of metal in vegetable species was revealed that *Vigna unguiculata*, *Raphanus sativus* are good accumulator of Cd and *Carica papaya* is not a good accumulator for any of the toxic elements. The vegetables Target Hazard Quotient (THQ) values were > 1 for Cd, Cr and Ni, which suggested that the health risk associated from consuming the vegetables were not fully safe. The Hazard Index (HI) values ($HI > 1$) were referred that children are more susceptible to noncarcinogenic risk rather than adults, with no carcinogenic risk. Implication of these findings will help to create awareness among people, as well as the Department of Agricultural Extension to take regulatory step to prevent the accessible accumulation of heavy metal in food chain by reducing the harmful agrochemical use.

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1.32 Effects of Moisture Content, Redox Potential and Plastic Char on The Growth of Red Amaranth (*Amaranthus Cruentus*) and Transfer of Cadmium from Soil to Plant

S. B. Quraishi, N. E- Alam, S. R. Khan, Mahfuza Akter*, Dr. Shamim Al Mamun*

Cadmium (Cd) contamination in agricultural soil is a global issue of concern because of its potential transfer to the human body through food chain interactions. This study was conducted to investigate the combined effects of plastic char, vermicompost, kitchen compost and urea under different water treatment to observe the plant

growth and transfer of cadmium depending on different redox potential. Fifteen treatments of different amendments along with one control (no treatment) treatment were used under three different water treated sets (300 ml, 150 ml and 50 ml) with three replications in total 135 number of pots. The study revealed that application of organic amendments individually or associatively, increased the growth of red amaranth. In all the cases application of plastic char alone (2 t/ha) increased the plant growth compared with the combined application of plastic char + vermicompost, plastic char + kitchen compost and plastic char+ urea at different amount. Plastic char mixed with vermicompost showed the maximum growth at the amount of 1 t/ha while decreased the growth 5 t/ha. Plastic char and kitchen compost also showed the similar effect. The highest Cd concentration found in the pot containing plastic char + urea (1 t/ha+ 200 kg/ha) for 300 ml water content whereas the lowest Cd concentration found in the pot containing plastic char alone (2 t/ha) for 150 ml of water content. Nevertheless, plastic char at higher at higher application rate individually or in associatively increased Cd uptake. Cd uptake by plant was varied not only with the different organic and inorganic amendments but also with the water concentration that applied in the soil. Transfer factor of Cd from soil to plants showed the maximum values for 300 ml water treated pots compared to the 150ml and 50 ml water treated pots. The THQ and TR values of Cd <1 for all the treatments, which indicates no potential non carcinogenic and carcinogenic risk. Further study is required to determine the potential of the plastic char produced from plastic waste in plant growth and heavy metal immobilization.

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1.33 Effects of Modification of Redox Potential and Plastic Char on the Growth and Cd Concentration of Red Amaranth (*Amaranthus cruentus*) and Microbial Community in Soil

S. B. Quraishi, N. E- Alam, S. R. Khan, Tasrin Sarker*, Dr. Shamim Al Mamun*

Soil, water, air and even foods are being contaminated with heavy metals due to rapid growth of industrialization, use of different fertilizers, pesticides and herbicides in agricultural fields. Contamination of agricultural soil by heavy metals, especially with Cd predominantly resulting from extensive use of inorganic fertilizers which is a prime environmental concern around the world. A pot experiment was conducted to assess the effects of plastic char that applied alone at 1 t/ha, 5 t/ha, 10 t/ha with or without artificial aeration on the growth and yield of red amaranth (*Amaranthus cruentus*) as well as on the uptake of Cd from contaminated soil. The values of pH, Electrical Conductivity (EC), Soil Organic Carbon (SOC), Soil Organic Matter (SOM), and microbial load were increased by the application of one time plate (10 t/ha) plastic char with artificial aeration. On the other hand, the values of soil redox potential with artificial aeration were comparatively higher rather than without aeration in experimental pots. The study revealed that the application of plastic char both surgical mask and one time plate increased fresh yield of red amaranth at each of the application rate. Similarly, the dose of surgical mask without artificial aeration at (1 t/ha) rate reduced Cd concentration by 14% whereas at higher application rate with artificial aeration (10 t/ha) increased the uptake of Cd concentration around 64% in red amaranth. Moreover, The values of target carcinogenic (TR) for Cd which indicating no carcinogenic risk for adults and children due to consumption of vegetables grown with different treatments while THQ < 1 indicates the population was assumed to be safe. Further study is required to determine the potential of the plastic char produced from plastic waste in plant growth.

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1.34 Evaluation of Heavy Metal Accumulation of Collected Leachate and Sediment Samples from the Treated and Untreated Leachate Ponds of Amin Bazar.

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

Amin Bazar, the sanitary landfill site in Dhaka city has been selected to assess the impact of dumping waste on environment. Concentration of heavy metals in sediment samples from the untreated and treated leachate pond were found in the descending order of Zn>Pb>Cr>Cu>Ni. The concentration of DO, BOD, COD, TDS and EC of untreated leachate were found 0.60, 81.66, 942.33, 7809 mg/L and 15655 µS/cm respectively, exceeding the inland surface water standard but after treatment the above parameters were found within the limit of safe value. Moreover, concentration of sediment sample from treated and unthread leachate pond showed higher value for Cr, Cu, Ni, Pb, and Zn according to WHO.

1.35 Assessment of Heavy Metal Concentrations and Nutrient Status of the Soil and the Corresponding Plant Sample in and around the Landfill Site.

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

Three different locations such as abandoned landfill, dumping and its surrounding agricultural areas of Amin Bazar landfill were selected for soil and plant sampling station. Results revealed that Cu, Ni, Zn concentrations were exceeded the permissible limit of soil suggested by different agencies and can be arranged as $Zn > Pb > Cr > Cu > Ni$. On the other hand plant samples did not show any significant contamination except Cu, Ni, and Zn, where they found to exceed the safe limit. Organic matter and nutrient concentration such as N, P, K, and S of both soil and plant showed desirable values.

1.36 Assessment of Groundwater Quality of BSCIC Tannery Industrial Estate, Hemayetpur, Savar, Dhaka

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

A total of 10 water samples were collected to evaluate groundwater quality by assessing physicochemical properties and heavy metal content and its associated health risk from 10 different locations around the BSCIC tannery industrial estate of Hemayetpur. Physical parameters such as temperature, electric conductivity (EC), salinity, and chemical parameters such as pH, total dissolved solids (TDS), heavy metals (Sr, Fe, Zn, Hg, Mn, Cu, As, Ni, Pb, Cr), anions (chloride, sulfate, nitrite, fluoride), and cations (calcium, magnesium, sodium, potassium) of the groundwater were measured at BSCIC tannery. Resultant data of those parameters revealed that the groundwater quality is still considerable range. Most of the parameters are within the drinking water quality standard set by Department of Environment (DoE) and WHO drinking water quality guideline. Only mercury concentration was found above the legislative value, indicating heavy metal pollution in the groundwater. The mean concentrations of heavy metals, anions and cations can be synchronized as $Sr > Fe > Zn > Hg > Mn > Cu > As > Ni > Pb > Cr$, Chloride > Sulfate > Nitrite > Fluoride and Calcium > Magnesium > Sodium > Potassium res

1.37 Heavy Metal Concentrations in Coastal Sediments and Water around Shitakunda Ship Dismantling Industrial Areas of Bangladesh

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

The purpose of this research is to find out the sources, concentrations, and transformation of metals (loid) from coastal ecosystem including inland water as well as obtaining the exposure scenario and carcinogenic and non-carcinogenic risks of heavy metals coming from the locality of ship recycling industry which may affect adversely in human health and environment of the entire area. A total of 40 sediment samples from the upper littoral (yard area) and lower littoral (saturated sediment) of the ship beaching area was collected from the study area. Water samples were collected from the offshore of the northern Bay of Bengal where ship breaking industries are densely located along with inland water samples that carries most of the debris of ship dismantling areas. For sediment samples, Energy Dispersive X-ray Fluorescence (EDXRF) Spectrometer and for water Atomic Absorption Spectrophotometer (AAS) were utilized for metal concentration determination. The physicochemical parameters of water such as pH, EC, DO, TDS, Turbidity, Alkalinity, Hardness, BOD, COD, Nitrate and Phosphate was also determined using standard analytical technique. The ecological risk index for the sediment of Shitakunda ship breaking area was found in the increasing order of $Cr < Zn < Cu < As < Pb$. Pb; pollution load index (PLI) value reflects the deterioration of the sediment quality; geo-accumulation index and enrichment Factor index revealed that the sediment samples of this study area were considerably polluted by the metals studied, especially by Pb, which is supported by the estimated ecological risk index value.

1.38 Evaluation of Heavy Metals in Sediment, Fishes and other Aquatic Animals Collected from Bongshi River, Savar and their Possible Health Risks Assessment

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

20 surface sediment samples and 6 aquatic animals were collected from the Bongshi river estuary for heavy metal analyses to assess the extent of metal pollution in sediment, fishes and other aquatic animals Savar, their source identification and ecological and health risk. Heavy metals were measured using EDXRF technique. Measured concentration of heavy metals in sediment samples follow the descending order as $Ca > Ti > Mn > Fe > Co > Cu > Zn > Rb > Sr > Zr > Nb > Pb$. According to PLI, Igeo, EF value it was found that the study

area was polluted from low to moderate level. On the other hand heavy metals in fish samples followed the descending order as $\text{Ca} > \text{Fe} > \text{Sr} > \text{Zn} > \text{Cu} > \text{Mn} > \text{Se} > \text{Cr} > \text{Ni} > \text{Hg} > \text{Pb}$. Estimated health risk indices due to consumption of studied fish samples revealed a safe value for the consumers.

1.39 Bioaccumulation of Trace Metals in Riverine Captured Fish and Riverbed Sediments of Karatoa River near Industrial Area in Bogura Sadar Upazila and Human Health Risk Assessment

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

The extent of metal pollution in sediment and fish in Karatoa river in Bogra, their source identification and ecological and health risk is important as monitoring of such parameter yet not done. Concentrations of metals in sediment samples were detected in the following order $\text{Fe} > \text{Ti} > \text{Mn} > \text{Zr} > \text{Zn} > \text{Rb} > \text{Cu} > \text{Sr} > \text{Co} > \text{Pb}$. The mean CF values along the all sediment samples followed the ascending order of $\text{Pb} > \text{Fe} > \text{Co} > \text{Mn} > \text{Sr} > \text{Rb} > \text{Zr} > \text{Zn} > \text{Cu} > \text{Ti}$. The PLI value was 0.734 all over the area indicating low pollution. In fish species, the concentrations of metals were detected in the following order $\text{Cu} > \text{Fe} > \text{Zn} > \text{Sr} > \text{Se} > \text{Mn} > \text{Rb} > \text{Pb} > \text{Co} > \text{Ni}$. For all samples, the MPI value ranged from 6.26 to 8.38, revealing low contamination. HRI values for fish and prawn species were less than 1 for all individual metals. The HI is also and it is below 1 and have no non-carcinogenic health effect.

1.40 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

14 agricultural soil samples were collected from two sides of Turag River and 14 plant samples regardless of species were also collected from the sampling stations for the appraisal of heavy metal pollution of sediment and plant on human health. Toxic elements viz: Cr, Ni, Co, Cu, Zn, As, Pb and Hg were measured using Energy Dispersive X-ray Fluorescence technique in both the soil and plant samples. Status of Toxic elements in agricultural soil and plants grown on the soils were evaluated. Moreover, determination of pollution degree by estimating various indices and multivariate statistical analysis was also employed to find out the possible pollution sources of Toxic elements in the soil samples were carried out. Health risk owing to soil-human and soil-plant-human route was assessed and translocation of heavy metals from soil to different parts of plants was also done to find out the metal extraction capability of the plants from a phytoremediation point of view.

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

Y.N. Jolly, J. Kabir, S. Akter, 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 desired 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

1.42 Evaluation of Pollutants in the Sediments and Fish Sample of Karnaphuli River and their Health Risk Assessment.

S. Akter, Y.N. Jolly, J. Kabir, K. M. Mamun, Nasrin Sultana, A. Shelley, Sazzadul Islam

The present study employed Energy Dispersive X-ray fluorescence (EDXRF) to investigate the levels of heavy metal concentration in sediments and fish samples of the Karnaphuli River. The average concentrations of heavy metals K 64595mg/kg, Ca 26041mg/kg, Ti 3052 mg/kg, Mn 390 mg/kg, Fe 15480 mg/kg, Cu 82.36 mg/kg, Zn 79.21mg/kg, Rb 80.88 mg/kg, Sr 74.33mg/kg, Zr 161.16 mg/gm and Pb 7.25mg/gm and the fish samples of heavy metals Ca, Cr, Mn, Fe, Co, Ni, Se, Rb, Sr, Hg and Pb also were determined. Total heavy metal concentrations in the sediment samples from the Karnaphuli River followed the order $\text{K} > \text{Ca} > \text{Fe} > \text{Ti} > \text{Mn} > \text{Zr} > \text{Cu} > \text{Rb} > \text{Zn} > \text{Sr} > \text{Pb}$. The fish samples of heavy metals was calculated to assess the level of contamination. These values were found to be lower than the global average values. Moreover, the

pollution load index, Enrichment factor and health risk assessment were also found to be within permissible limits. Consequently, the results suggest no risk of pollution from heavy metal. Overall, this study emphasizes the importance of monitoring and assessing the levels of toxic and essential elements to ensure the safety of human health and the environment. While the results suggest no potential risks, further investigation and risk assessment may be necessary.

1.43 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

The primary goal of this research was to determine the seasonal variation of PM_{2.5} over a one-year period (2020), as well as any possible links between air pollution and meteorological variables. The pollutant has lower concentrations during warmer periods, especially during summer, and significantly greater concentrations during the heating season in winter, due to seasonal variation in energy consumption (biomass burning) and air stability. Following that, the greatest PM_{2.5} concentration was 94.5 µgm⁻³, which is three times greater than the highest monthly mean. Our findings show a negative association between PM_{2.5} and temperature (-0.17), PM_{2.5} and rainfall (-0.51), PM_{2.5} and humidity (-0.021), and a positive correlation between PM_{2.5} and wind direction (0.016). The trajectories and source receptor association of PM_{2.5} were also assessed using trajectory cluster analysis and concentration-weighted trajectory (CWT) methods. The results showed that during the post-monsoon season, a higher CWT value is seen originating from the Myanmar location, which is around 35 to 40 µgm⁻³ with a probability range of 0.12 to 0.14. During the monsoon season, the Bay of Bengal is a possible source of PM_{2.5} in where the area's associated CWT value is 20 µgm⁻³.

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1.44 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*, M.S. Rahman

Particulate air pollution is the major concern in Bangladesh and thus it is necessary to understand the characteristics of the pollutant as well as sources for further improvement of the air quality. In this view, particulate matter (PM) sampling was done between January 2019 to February 2020 at two Continuous Air Monitoring Stations located at Atomic Energy Centre and Darussalam in Dhaka city. PM sampling was performed using dichotomous samplers, which collect samples in two sizes: PM_{2.5} and PM_{2.5-10}. Samples were collected on 37 mm Teflon filters. These filters were weighed for PM mass, analyzed for BC by transmissometers and elements by XRF. Data reveal that the pollution from particulate matter varies greatly with climatic conditions. It was found that the PM and BC concentrations in Darussalam were higher than Atomic Energy Centre, Dhaka. A major cause might be transboundary transport of pollutants from agricultural burning in upwind regions. This result was surprising given the number of brick kilns, bus terminals and industrial emissions in Darussalam Dhaka is greater than Atomic Energy Centre area. But in this time soil dust is very high in Atomic Energy Centre area for metro-rail project. Principal component analysis method and Positive Matrix Factorization (PMF) 5.0 was used to find out the fingerprint of different sources, which are responsible for polluting the atmospheric air and effect of health.

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1.45 Wintertime Exposure of Indoor Particulate Matter and Health Risk Assessment of PM_{2.5} on the Residents in Dhaka, Bangladesh

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

Real time concentration of indoor PM_{2.5} and PM₁₀ were measured using IGERESS Air Quality Monitoring Detector at residential homes of six locations in Dhaka. Mean I/O ratio (1/Oday= 0.95 and 1/Onight= 0.93) and strong positive correlation (R_{2day}= 0.90 and R_{2night}= 0.80) between indoor and outdoor particulate matter confirmed infiltration of outdoor air in households. Enrichment factor analysis revealed that Pb, Cr, Zn, and Cu had anthropogenic origin, whereas Fe and Mn. originated from crustal sources. Four sources of indoor PM_{2.5} were identified by Positive Matrix Factorization (PMF) model - industrial emission (4.8%), crustal sources (17.6%), traffic sources (44.6%), and mixed sources (32.9%). Health risk assessment indicated that children were at 2.18 times greater non-carcinogenic risk than adults, the hazard index values for children and adult

being 8.28 and 3.79, respectively. The total cancer risk was 5.18×10^4 (1 in 1930 individuals), which was higher than the acceptable limit (1×10^{-6}). The average peak flow rate and blood oxygen saturation of thirty inhabitants in six sampling locations were 353 L min^{-1} and 98.7%, respectively. Strong, negative correlation ($R^2 = 0.82$) between peak flow rate and indoor $\text{PM}_{2.5}$ concentration suggested that inhalation of elevated level of $\text{PM}_{2.5}$ was probably responsible for reduced lung efficacy. However, blood oxygen saturation was independent of indoor $\text{PM}_{2.5}$ concentrations. The average hazard ratio for indoor $\text{PM}_{2.5}$ was 6.68, which indicated highly degraded indoor air quality across Dhaka, Bangladesh.

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1.46 Ambient Concentration of Particulate Matter $\text{PM}_{2.5}$ and Black Carbon: A Comparative Study of Two Different Locations in Dhaka City

B.A. Begum, K. Begum*, F. Muhammad*, M.A.M. Sarkar, M. Hasan, M. S. Rahman

A year-wise comparison of the collected $\text{PM}_{2.5}$ and BC (Black Carbon) samples has been shown. The eight-year average annual mean of $\text{PM}_{2.5}$ mass concentration was above the national ambient air quality limit of $15 \text{ } (\mu\text{gm}^{-3})$ for $\text{PM}_{2.5}$. The mean yearly mass concentration of $\text{PM}_{2.5}$ was much higher in 2011, 2016, and 2017. The semi-residential (SR) (AECD) site was with relatively more minor traffic, but the Darussalam site (CAMS-3) was with high traffic. As a result, BC at the Darussalam site was 32% of the total $\text{PM}_{2.5}$. The BC value was about 25% of the total $\text{PM}_{2.5}$ at the SR site, mainly of anthropogenic origin and predominately from transport-related sources. Due to the meteorological reason and long-range transport during the winter, the PM concentrations remain much higher than the Bangladesh Standard.

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1.47 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

In this research work, fine particulate matter ($\text{PM}_{2.5}$) and Black Carbon (BC) were collected from a semi residential site located at Dhaka university campus starting from march 2018 to february 2019. Then the mass concentrations of $\text{PM}_{2.5}$ and BC were measured. The mean $\text{BC}/\text{PM}_{2.5}$ ratio was found to be 0.256. $\text{BC}/\text{PM}_{2.5}$ ratio varies from 0.01 to 0.70 during the study period. Then the influences of meteorological parameters on $\text{PM}_{2.5}$ and BC mass concentrations have been studied. Temporal and Seasonal variations of $\text{PM}_{2.5}$ and BC were also studied. From the time variation analysis, it was observed that in winter both $\text{PM}_{2.5}$ and BC have high mass concentrations and it falls down gradually during the summer time. Then to understand the meteorological effects various kinds of statistical analysis were done such as seasonal correlation between the measured variables based on Pearson correlation method and for source identification of the pollutants Bivariate polar plots and K-means Clustering methods were used. Back trajectory clustering has been used to illustrate the transport pathways of air masses and the cluster pathways for each season was also investigated. The PSCF and CWT maps were used to describe the potential source areas of $\text{PM}_{2.5}$.

1.48 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 investigated the variations of 16 hourly average concentrations of fine particulate matter ($\text{PM}_{2.5}$) and Black Carbon (BC) in 4 consecutive winter seasons (December-February) starting from 2014 to 2018 named as winter-01, winter-02, winter-03 and winter-04 using Gent sampler in capital city Dhaka, Bangladesh. To understand the contribution of BC to the $\text{PM}_{2.5}$ pollution, the ratio of $\text{BC}/\text{PM}_{2.5}$ is considered which ranges from 0.02 to 0.52 indicating the dominance of BC over the fine particulate matter may be due to the brick kiln emissions, motor vehicle emission etc. To detect the transport pathway of air masses and the presence of specific emission sources that enhance the pollution over receptor sites, Back trajectory clustering and the potential source contribution function (PSCF) are employed in the present study respectively. Concentration weighted trajectory analysis using the 5-day back trajectory (by HYSPLIT-4 model) is also employed in the present study to discover the impact of transboundary pollution. Air mass trajectory analysis with HYSPLIT-4 model showed that the long range transport especially from the north and northwesterly countries e.g., Afghanistan, Pakistan, Nepal and various province of India may be appreciably contributed to the $\text{PM}_{2.5}$.

concentrations at the study area apart from local emission sources. Hence there was a huge pollution during winter season.

1.49 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

Like many other mega cities of developing countries, noise pollution in Dhaka city of Bangladesh is a big concern. Exposure to high level noise may cause severe stress on the auditory and nervous system of the city dwellers, particularly the children. The extreme effects e.g. deafness and mental breakdown are also occasionally reported. The data have been analyzed to calculate various noise parameters. It is observed that, the mean noise level was 68.83 at morning, whereas, it was 69.21 at afternoon; the maximum noise level was 80.81 at morning, whereas, it was 96.75 at afternoon; and the minimum noise level was 55.45 at morning, whereas, it was 55.45 at afternoon. It is noticed that, the level of noise remains above the acceptable limit sometime. Comparison of present results with the existing previous results shows that noise level in the Dhaka city is increasing day by day. The paper suggests that urgent measures should be taken into consideration to control the level of noise pollution in the city.

1.50 Personal Exposure to Household Air Pollution and Lung Function in Rural Bangladesh: A Population-Based Cross-Sectional Study.

B.A. Begum, M.A.H. Chowdhury, S.B. Kader*

It is aimed to whether personal exposure to household air pollution [$PM_{2.5}$ and black carbon (BC)] is associated with lung functions (FEV1, FVC, and their ratio) in non-smoking adults in rural Bangladesh. It is measured personal exposure to $PM_{2.5}$ using gravimetric analysis of $PM_{2.5}$ mass and BC by reflectance measurement between April 2016 and June 2019. The average 24-hour $PM_{2.5}$ and BC concentration was $141.0 \mu g m^{-3}$ and $13.8 \mu g m^{-3}$ for females, and $91.7 \mu g m^{-3}$ and $10.1 \mu g m^{-3}$ for males, respectively. A $1 \mu g m^{-3}$ increase in $PM_{2.5}$ resulted in a 0.02 ml reduction in FEV1, 0.43 ml reduction in FVC, and 0.004% reduction in FEV1/FVC. We also found a similar inverse relationship between BC and lung functions (9.6 ml decrease in FEV1 and 18.5 ml decrease in FVC per $1 \mu g m^{-3}$ increase in BC). A higher proportion of non-smoking biomass fuel users (50.1% of the females and 46.7% of the males) had restrictive patterns of lung function abnormalities, which need further exploration.

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1.51 Exposure to Household Air Pollution (HAP) and Measures of Central Hemodynamic Parameters Among Bangladeshi Population- A Cross-Sectional Study.

B. A. Begum, M. Hasan*, M. A. H. Chowdhury, S. Ahmed, M. Eunos, S. B. Kader

To perform a cross-sectional study to assess the associations of HAP with an array of adverse health hazards, including cardiovascular mortality and morbidity. We assessed central hemodynamic parameters-Systolic Blood Pressure (SBP), Diastolic Blood Pressure (DBP), and Heart rate (HR) using a standard cuff sphygmomanometer (Omron) and Mean Arterial Pressure (MAP) and Pulse Pressure (PP) using the standard formula. The exposures to particulate matter; $2.5 \mu m$ ($PM_{2.5}$) and Black Carbon (BC) from biomass fuel were measured for 24 hours using a personal monitor, RTI MicroPEM (RTI International, NC), among healthy, non-smoking women ($n=400$) and men ($n=200$). A multiple linear regression model adjusted for potential confounders was used to examine the association between HAP exposures and hemodynamic outcomes. In the adjusted multivariable regression model, an 1% increase in BC resulted in a 1.6 mm of Hg reduction in MAP (95% CI: -3.24, -.03 mm of Hg, $P=0.04$), 2.8 mm of Hg increase in PP (95% CI: 1.55, 4.22 mm of Hg, $P=0.00$) and 2.6 mm of Hg reduction in DBP (95% CI: -4.09, -1.10 mm of Hg, $P=0.00$). No association was observed between BC and SBP as well as BC and HR. $PM_{2.5}$ was not associated with any of the hemodynamic parameters even after adjusting for age, cooking duration, household income, and Body mass index (BMI). This population-based study provides evidence that exposure to HAP (BC) is linked with central hemodynamic parameters, especially MAP and PP, which have negative implications for cardiovascular health when they become high and low. HAP, Hemodynamics, Bangladesh.

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

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

PM sampling was performed using a GENT sampler, which collects samples in two size fractions: PM_{2.5} and PM_{2.5-10}. Seasonal variations of PM_{2.5} and BC were also studied in Dhaka city from 2014 to 2020. It has been observed that in winter both PM_{2.5} and BC has maximum concentrations and the mean concentrations were measured to be 60 µgm for PM_{2.5} and for BC it was 9.5 5 ugm. Data on the concentrations of 17 elements (Na, Mg, Al, Si, S, Cl, K, Ca, Ti, V, Mn, Fe, Ni, Cu, Zn, Br, and Pb), black carbon and mass were available for data analysis. Source apportionment of the trace elements in PM_{2.5} was done by using Positive Matrix Factorization (PMF) technique. The identified sources include brick kilns, soil dust, road dust, motor vehicle, fugitive Pb, Zn source, Biomass burning and sea salt sources. Among them, Brick kiln contributes the highest followed by road dust and motor vehicle. It was found that more than 49.5% of the fine particle mass comes from anthropogenic sources such as brick kilns, biomass burning, and motor vehicles.

1.53 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

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

The aerosol masses of the fine fractions were determined by weighing the filters before and after exposure using a microbalance (METTLER Model MT5) and PM_{2.5} samples were analyzed by an EEL-type Smoke Stain Reflectometer to measure Black carbon (BC) at a semi-residential & industrial site in Dhaka city. The trace elements in PM_{2.5} samples were analyzed by using a Thermo Scientific ARL QUANT'X energy dispersive X-ray fluorescence spectrometer (ED-XRF). Data on the concentrations of 18 elements (Na, Mg, Al, Si, S, Cl, K, Ca, Ti, V, Mn, Cr, Fe, Ni, Cu, Zn, Br, and Pb), black carbon, and mass were available for source identifications. Source apportionment was done by using both the multivariate statistical techniques principal component analysis (PCA) and positive matrix factorization (PMF 5.0) methods. This study revealed that the possible sources at the study area are brick kilns, soil dust, road dust, motor vehicle, fugitive Pb, biomass burning and sea salt sources.

1.54 Heavy Metal Accumulation and Phytoremediation Potentiality of Some Selected Mangrove Species from the World's Largest Mangrove Forest

M.S. Rahman, M.A.M. Sarkar, M.M. Hasan, Z. Masum*, B.A. Begum

In this study, samples of sediment and three mangrove species (*Excoecaria agallocha*, *Avicennia officinalis*, *Sonneratia apetala*) were collected from the world's largest mangrove forest (along the Northern Bay of Bengal Coast) with the aim of evaluating metal concentrations, contamination degrees, and phytoremediation potentiality of those plants. Overall, the heavy metals concentration in sediment ranged from Cu: 72.41–95.89 mg/kg; Zn: 51.28–71.20 mg/kg; Fe: 22,760–27,470 mg/kg; Mn: 80.37–116.37 mg/kg; Sr: 167.92–221.44 mg/kg. The values of Igeo (Geo-accumulation index) and CF showed that the area was unpolluted to moderately polluted by Zn, Fe, Mn, Cu and Sr. Enrichment factor (EF) values in both sampling stations portrayed moderate to minimum enrichment. Phytoremediation potentiality of the species was assessed by bioconcentration factor (BCF) and translocation factor (TF). BCF values showed less accumulation for most of the heavy metals (1).

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1.55 Reuse of Gamma-Ray Irradiated Textile Waste Water: Implications on the Growth of *Capsicum Frutescens* Plant

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This investigation concentrates on the possibility of using gamma radiation for the decomposition of organic pollutants in textile wastewater and reuse as irrigation water. The wastewater sample was irradiated at four different absorbed doses of 3, 5, 8, and 10 kilo Gray (kGy). The treated textile wastewater samples were reused to grow *Capsicum frutescens* plants to inspect the fertility responses. When *Capsicum* plants were nourished by textile wastewater irradiated at 8–10 kGy, increased values were observed in the plant morphological

parameters such as dry masses of the fruits (from 2.25 to 3.02 g), moisture content (from 91.35 to 92.62%), root length (from 13.21 to 16.56 cm), average plant height (from 2.42 to 4.07 cm/week), average number of leaves (from 14 to 16 nos./week), and total number of fruits (from 25 to 40 nos.) in comparison to those plants nourished by simply water and raw wastewater. The elemental analysis confirmed that negligible amounts of heavy metals were found in Capsicum fruits at higher absorbed doses. In contrast, helpful macro and micronutrients for plant production were raised to sufficient levels at 8–10 kGy, which can be the optimum doses for gamma irradiation to treat textile wastewater for maintaining sustainable water resources.

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1.56 Di 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

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Energy dispersive X-ray fluorescence (ED-XRF) was used to quantify trace metal concentration in edible parts of the fish species. This study revealed that the rank of the trace metals concentration was as follows (mg/kg): Zn (37.1) > Mn (16.12) > V (11.16) > Cu (9.49) > Rb (5.62) > Pb (2.98) > Cr (1.59) > Co (1.17). The metal pollution index (MPI) in the muscle of fishes were found to be in the following order: *L. bata* > *P. monodon* > *T. cirratus* > *M. bleekeri* > *O. pabda* > *H. nehereus* > *L. calcarifer* > *P. argenteus* > *P. paradiseus* > *T. toli*, and the MPIs for most of the benthic fish species were higher compared to the pelagic fishes. For the human health risk assessment concern, estimated daily intake, target hazard quotient and cancer-causing risk were estimated. The results for non-cancer hazardous index values were found to be lower than unity. On the other hand, the total cancer risk data ranging from $1.24\text{E}-05$ to $1.70\text{E}-05$ were fallen within the range for the threshold values ($1.0\text{E}-06$ to $1.0\text{E}-04$). However, considering the suggested values set by the environmental and regulatory agencies, it has been recommended that no significant non-carcinogenic and cancer-causing health risk for humans was seen due to the consumption of the studied fish species.

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1.57 Si Simultaneous Abatement of Ni²⁺ and Cu²⁺ Effectually from Industrial Waste Water by a Low Costnatural Clay-Chitosan Nanocomposite Filter: Synthesis, Characterization and Fixed Bed Column Adsorption Study

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Chitosan was synthesized following demineralization, deproteinized and finally by 50 % NaOH treatment. On contrary, ACCBNF were contrived by solution casting method. The characterization of ACCBNF composites was done by FTIR, XRD, SEM and TGA techniques. The influence of different parameters such as initial concentration of wastewater (40–60 ppm), flow rate of wastewater (3–5 mL/min) and bed height of column (1.5–3.5 cm) were explored appropriately for this study, where the amount of adsorbents were inter between to 2.57–5.98 g. This study revealed that the fictitious ACCBNF composites were highly crystalline, thermally stable, and have worthy surface activity and exhibit a very astonishing adsorption capacity against Ni²⁺ and Cu²⁺. The uppermost R% was found around 81.13 % for Ni²⁺ and 88.88 % for Cu²⁺ ions respectively additionally the maximum adsorption capacity were found particularly for Ni²⁺ around 101.24 mg/g and for Cu²⁺ around 94.14 mg/g.

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1.58 Mi Microplastics in Aquatic Environments: A Comprehensive Review of Toxicity, Removal, and Remediation Strategies

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This study mainly aims to review the Toxicity of MPs along with plastic additives in aquatic organisms at various trophic compartments and available remediation methods/strategies for MPs in aquatic environments. Occurrences of oxidative stress, neurotoxicity, and alterations in enzyme activity, growth, and feeding performance were identical in fish due to MPs toxicity. On the other hand, growth inhibition and ROS formation were observed in most of the microalgae species. In zooplankton, potential impacts were acceleration of premature molting, growth retardation, mortality increase, feeding behaviour, lipid accumulation, and decreased reproduction activity. MPs together with additive contaminants could also exert

some toxicological impacts on polychaete, including neurotoxicity, destabilization of the cytoskeleton, reduced feeding rate, growth, survivability and burrowing ability, weight loss, and high rate of mRNA transcription. Among different chemical and biological treatments for MPs, high removal rates have been reported for coagulation and filtration (>86.5 %), electrocoagulation (>90 %), advanced oxidation process (AOPs) (30 % to 95 %), primary sedimentation/Grit chamber (16.5 % to 58.84 %), adsorption removal technique (>95 %), magnetic filtration (78 % to 93 %), oil film extraction (>95 %), and density separation (95 % to 100 %).

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1.59 Hy Hydrothermal Synthesis of Cobalt Substitute Zinc-Ferrite (Co_{1-x}Zn_xFe₂O₄) Nanodot, Functionalised by Polyaniline with Enhanced Photocatalytic Activity Under Visible Light Irradiation

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The hydrothermal synthesis of nanodots of Co_{1-x}Zn_xFe₂O₄ (x = 0.3, 0.5 and 0.7), coated with polyaniline, by in situ polymerization. The Co_{1-x}Zn_xFe₂O₄ nanodots, coated with polyaniline (PANI) nanograins, facilitated optical properties by easily capturing visible light. X-ray Diffraction (XRD) patterns and Scanning Electron Microscopy (SEM) images have confirmed the single-phase spinel structure of Co_{1-x}Zn_xFe₂O₄ nanodot and nano-pore size of the Co_{1-x}Zn_xFe₂O₄/PANI nano photocatalyst. The specific surface area of the Brunauer–Emmett–Teller (BET) of the Co_{1-x}Zn_xFe₂O₄/PANI photocatalyst was determined to be 24.50 m²/g by multipoint analysis. The final Co_{1-x}Zn_xFe₂O₄/PANI (x = 0.5) nano photocatalyst showed high efficiency in the catalytic degradation of toxic dyes (~98% within 5 min), with good mechanical stability and recyclability under visible light irradiation. The nano photocatalyst was re-used and its efficiency was largely maintained, even after seven cycles (~82%) of degradation. According to the Pseudo-first-order kinetic model, photo degradation data followed the first-order reaction rate (R² > 0.95) of degradation of dyes. In conclusion, a simple and low-cost synthesis process, speedy degradation and excellent stability of polyanilinecoated Co_{1-x}Zn_xFe₂O₄ nano photocatalyst could be used as a promising photocatalyst for dye waste water treatment.

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1.60 M Managing the Invisible Threat of Microplastics in Marine Ecosystems: Lessons from Coast of the Bay of Bengal

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The review aims to highlight the multi-environmental hotspots, ecotoxicity effects, sources, fates, and intervention measures of MP in the northeastern BoB to understand how MP spreads in the nearshore marine ecosystem. This study critically evaluates the hotspots and ecotoxic effects of pollution from MP on the coastal multi-environment, e.g., soil, sediment, salt, water, and fish, as well as current intervention measures and additional mitigation recommendations. This study identified the northeastern part of the BoB as a hotspot for MP. In addition, the transport mechanisms and fate of MP in different environmental compartments are highlighted, as are research gaps and potential future research areas. Research on the ecotoxic effects of MP on BoB marine ecosystems must be a top priority, given the increasing use of plastics and the presence of significant marine products worldwide. The knowledge gained from this study would inform decision-makers and stakeholders in a way that could reduce the impact of the legacy of micro- and nanoplastics in the area. This study also proposes structural and non-structural measures to mitigate the effects of MPs and promote sustainable management.

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1.61 Combined Application of EPANET and Empirical Model for Possible Formation of Trihalomethanes in Water Distribution Network of Chattogram City to Identify Potential Carcinogenic Health Risk Zone

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The study identifies potential carcinogenic health risk-zone of Chattogram city for the occurrence of trihalomethanes (THMs) at its water distribution network. The EPANET-THMs simulation model along with an empirical model have been adopted in the study to predict THMs content of supply water of the distribution network of the city's Karnaphuli service area. The simulation (R² = 0.7) shows that THMs' concentrations throughout the network vary from 33 to 486 µg/L. Around 60% of total junctions showed THMs

concentrations above 150 µg/L, while that is above 50 µg/L for most (99%) of the junctions. Residual Free chlorine, one of the precursors for the THMs formation in distribution line, has also been simulated by EPANET considering varying applied chlorine dose at the water purification unit and wall (Kw) and bulk (Kb) decay constants. The simulated free residual chlorine peaks are found to be closer to the actual values with chlorine dose of 2 mg/L, and decay constants, Kw = 1 d⁻¹ and Kb = 1 d⁻¹. A mean lifetime total risk of cancer due to the presence of THMs has been found to be very high. Furthermore, the application of EPANET in combination with an empirical model could be an effective tool for predicting THMs' concentration in water distribution networks in developing countries like Bangladesh to minimize the expenses of measuring THMs.

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1.62 Assessment of Water Quality Parameters in Five Major Rivers in Dhaka Region of Bangladesh

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Anthropogenic pollution plays an important part in deteriorating the water quality of rivers all over the world, especially in urban areas where water quality monitoring is still seriously constrained by the limited test facility and capability. In this study, we aimed to evaluate the impact of urbanization on river water quality, and to investigate five typical urban rivers of Dhaka through the upper-urban-down gradient assessment approach as well as analyze by water quality index (WQI) and statistical methods. Dhaka city is surrounded by a number of rivers and canals of which Turag, Buriganga, Bangshi, Balu and Shitalakshya are the important ones. The Buriganga, Shitalakshya, Balu, Turag and Bangshi are such rivers those are extremely polluted through various human activities along their courses. These rivers have been so extremely polluted that these have turned into the rivers of poison. The poisonous waters of these rivers have not only been killing all its aquatic life but also posing health hazards to the dwellers of the city. In this study, water samples have been collected from these five rivers and physico-chemical parameters and heavy metals are investigated. The work is in progress.

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1.63 Multi-Dimensional Approach for an Environmental Health Assessment of a Deltaic Mangrove Ecosystem, Sundarbans

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The largest contiguous tract of tidal halophytic mangroves in Bangladesh is about 10,000 km². It has a wide range of physiochemical and nutritional qualities, as well as ecological health. Thus, this study was executed to understand the environmental status such as water quality, sediment moisture and heavy metals, plankton diversity, and biotic integrity of the mangrove ecosystem in Bangladesh. To understand the hazardous and heavy metal concentrations, ten heavy metals concentrations were examined in both water and sediment. Indices for pollution and contamination, such as Modified Hazard Quotient (mHQ), Degree of Contamination (Cd), Geo-Accumulation Index (Igeo), Mean Effect Range Median Quotient (M-ERM-Q), Nemerow's Pollution Index (NPI), Heavy Metal Evaluation Index (HEI) give a more accurate diagnostic result for water and sediment in the Sundarbans mangroves. The Water Quality Index (WQI) and Mangrove Quality Index (MQI) are also evaluated for a final statement. The nutrient concentrations average of NO₃, PO₄, NH₃, and SiO₂ are found 0.59 ± 0.05, 0.09 ± 0.01, 0.23 ± 0.02 and 1.72 ± 0.17 (mg/L), respectively in water. Pb, Cd, Hg, As, Cr, Mn, Fe, Ni, Cu, and Zn have average concentrations of 19.1 ± 1.62, 1.1 ± 0.11, 0.48 ± 0.04, 1.19 ± 0.11, 83.27 ± 8.3, 35.45 ± 2.95, 282.73 ± 30.82, 33.85 ± 2.95, 6.09 ± 0.54, and 172.18 ± 17.15 (µg/L) in surface water and 19.57 ± 1.25, 0.16 ± 0.005, 0.026 ± 0.0009, 1.48 ± 0.08, 36.38 ± 4.31, 456.66 ± 76.76, 42.36 ± 2.57, 53.81 ± 1.93, 20.67 ± 1.24, and 43.60 ± 6.09 (mg/kg) for sediments. According to the heavy metals analysis indices, we discovered very little contamination. The WQI indicates that the water quality in the Sundarbans Mangroves is generally protected but occasionally deteriorates. The MQI categorizes the Sundarbans as a moderate mangrove, falling into category 3. Despite being controlled the heavy metal pollution is getting worse as the Mongla port's economy grows. A more seasonal and in-depth approach to this topic can be achieved by collecting more samples over a year. The deltaic Sundarbans mangrove ecosystem is currently in moderate to an acceptable condition, with low or non-significant pollution levels and fair water quality, according to this study, except for certain constraints.

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1.64 Contamination and Ecological Risk Assessment of Metal(loid)s in Sediments of Two Major Seaports along Bay of Bengal Coast

T. R. Choudhury, M.N Alam, M. A. Maksud, S. R. Khan, L. N. Lutfa, M. Y. Aftad*, M. B. Hossain*, S. B. Quraishi

Pollution from shipping, industrial, and municipal wastewater discharges is a major source of heavy-metal contamination at seaports located near estuaries or along the coast. In this study, for the first time, nine metal(loid)s (Pb, Cd, Cr, Cu, Mn, Zn, Ni, Fe, and As) were analyzed from the surface sediment of two major seaports on the Bay of Bengal coast to evaluate the degree of pollution and ecological risk.

The average concentrations of metal(loid)s followed the decreasing order of Fe ($53,800 \pm 4002$ mg/kg) > Mn (590 ± 116.8 mg/kg) > Zn (67.59 ± 13.5 mg/kg) > Ni (62.8 ± 22.5 mg/kg) > Cr (36.59 ± 7.22 mg/kg) > Cu (32.63 ± 6.78 mg/kg) > Pb (16.78 ± 3.93 mg/kg) > As (6.33 ± 1.9 mg/kg) > Cd (0.71 ± 0.16 mg/kg). Both sites had much greater Fe concentrations (compared to other metals) than the levels that had been previously recorded at nearby localities. Furthermore, elements such as Fe and Ni surpassed the recommended NOAA and EPA limits for maximum samples from both ports. However, with the exception of one sampling point in Chattogram Port, the pollution-load-index (PLI) values were $< CF < 3$ for Cd and 0). In addition, the potential ecological-risk index (PERI) revealed that the both areas are under considerable (PERI > 80) to moderate (PERI > 40) risk due to Cd pollution. Correlation and Principal Component Analyses (PCA), demonstrated the anthropogenic sources of some metals, especially Fe, Ni, and Cd. As a result, it is suggested that the study area should be followed up on, to track changes and design a pollution-control strategy to reduce future pollution hazards.

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1.65 Vertical Distribution, Contamination Status and Ecological Risk Assessment of Heavy Metals in Core Sediments from a Mangrove-Dominated Tropical River

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Understanding the vertical distribution of heavy metals aids in tracing the contamination history, however, it is limited for mangrove-dominated river. Thus, this study aimed to assess the vertical distribution of nine heavy metals and their possible ecological risk in several layers of core sediments from a mangrove-dominated river inside the Sundarban mangrove forest (World heritage and Ramsar site), Bangladesh. 45 core samples from five stations were analyzed using Flame Atomic Absorption Spectrophotometer (FAAS). The findings showed that, with the exception of Fe, Ni, and Cu, which suggested increased metal release in recent times, higher metal levels were recorded in the surface layer (0–10 cm), followed by the middle layer (10–20 cm), and inner layer (20–30 cm) of sediment cores. When compared to non-industrial forest sediment, core sediment from industrial sites contained noticeably more metals ($p < 0.05$). Overall, the mean metal concentration (mg/kg) followed the increasing order of Cd < As < Pb < Cu < Cr < Zn < Ni < Mn < Fe. Among the studied metals, the levels of Cd and Ni exceeded the average shale value. Contamination indices such as enrichment factor (EF), contamination factor (CF), and geo-accumulation index (Igeo) showed that the studied sediments were only contaminated by Cd. Ecological risk assessed by ecological risk factor (Ei r) and risk index (RI) suggested that the analyzed heavy metals, with the exception of Cd, posed no significant ecological threats. All of the heavy metals analyzed might have originated from similar anthropogenic sources, according to the correlation matrix, cluster analysis (CA), and principal component analysis (PCA). 1.

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1.66 Assessing and Improvement of 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; B. A. Begum

The objective of this study is to assess the drinking water quality and to improve sustainable drinking water management system in the Bengal Delta with the effect of climate change. In the middle part of the Bengal delta, drinking water were collected from several (9) primary schools, adjacent local communities' tube well (10) at about 1 km interval from Kotchandpur thana. Also, water was collected from a recently developed water purifier company (1) to assess existing drinking water management system. In every location, water was

collected from both shallow (< 50 m) and nearby deep (>100 m) tube wells. Water samples were collected in dry and wet season to understand the seasonal variations with climate change. Metals (Fe, Mn, Pb, Zn etc.) and metalloid (As) are determined in all water samples by using ICP-OES. Physical parameters (pH, EC, TDS) were determined onsite and in laboratory too. A significant variation of metal conc. observed in dry and wet season. Results showed that samples from several existing/ active tube wells contain higher amount of As with Fe, Mn concentration is max 399.7, 6794.2, and 604.8 µg/L respectively in dry season, which are higher than the concentration in wet season (77.8, 766.6, and 460.1 µg/L respectively). Three tube well samples out of nine samples showed three-to-eight -fold higher value of As concentration than the permissible limit. This work is in progress.

1.67 Analysis of Metal Concentrations in Water-Soil-Vegetation of the Dhaleshari River: An Overview of the Challenge to Achieve SDG

S. Hossain; M. Sultana*; M. Parveen*; K. M. Mamun; J. Kabir; S. Akter; Y. N. Jolly

The present study was sketched to determine the current state of pollution rate at adjacent to Dhaleswari River (upstream, downstream, and mainstream) in agricultural soils and plants and to identify potential challenges to achieve SDG target related with water and land resources sustainability. The study used four samples of surface water, as well as four samples of soil and plant from the Dhaleswari River in the Keraniganj area of the Dhaka districts. Samples were analyzed for K, Ca, Fe, Mn, Cu, Zn, Sr, Pb, Ni, and Cr by Energy Dispersive X-ray Fluorescence (EDXRF). In surface water the mean concentration of Fe, Mn, Cu, Zn, Sr, and Pb were found to be 28.08, 5.68, 5.02, 6.26, 44.68, 3.56 µg/L, Ni and Cr are below the detection limit respectively. The concentration of K, Ca, Mn, Fe, Cu, Zn, Sr, and Pb in Soil samples were found to be 6428.04, 30030, 688.98, 46020, 30.95, 101.58, and 119.99 mg/ kg, respectively. The Maximum elemental concentration in Soil of Dhaleswari River was above the recommended safe limits by US-EPA, Geoaccumulation index and enrichment factor values indicate the samples as noncontaminated to moderate contaminated. Results showed that concentration of K, Ca, Cu, Zn, Mn, and Sr in soil is lower than the Standard value and Fe and Pb is higher than the Standard value. Sustainable Development Goal (SDG)s that deal with environmental dimensions (Goals 6, 11, 14, and 15) are positively related to the actions needed to ensure the Dhaleswari River's long-term sustainability since these actions reinforce one another.

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1.68 Elemental Analysis of Water, Soil, and Vegetables Adjacent Area of the Shitalakhya River, Bangladesh

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The present study investigated the bioavailability of various elements in water, soil, and vegetables along the Shitalakhya river, Bangladesh to understand environmental ecological and health risk assessment in the adjacent area of Shitalakya river. Four sampling location were selected from Ghorashal and Narshindi area. The samples were analysed by EDXRF technique for elements such as Potassium (K), Calcium (Ca), Zinc (Zn), Arsenic (As), Rubidium (Rb), Strontium (Sr), and Lead (Pb). The result showed that only Zn, Fe, and Mn concentration in soil exceeds the permissible limit which are ranged as, 73.3-129.1, 41080-48650, 488.6-677.8 mg/kg respectively. However, vegetables showed relatively higher value of Pb (ranged 19.9-29.5 mg/kg) concentration in three samples. On the other hand, river water didn't show any higher value of metals and trace elements than the standard value of WHO and Bangladesh. It is necessary to find out the possible source of Pb in vegetables. Several standards were compared to understand their distribution and will be assessed environmental ecological and health risk using different risk assessment codes. The work is in progress.

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1.69 Mineralogical Evaluation of Sediment of the Kuakata Coastline Area of the Bay of Bengal.

S. Hossain; A.A.Mahmood*; T. Hamid*; Y. N. Jolly; H.N. Das; S.M. Haque

There were 12 marine sediment samples were collected at the coastal line of Kuakata area to determine the mineral content in the coastal area of Bay of Bengal. Mineralogy were determined after analysis all samples by XRD techniques. Minerals were determined within 3° to 72° 2 theta value range. Primary minerals like Quartz, feldspar and other minerals were determined where quartz is the main minerals in all samples. Peaks of clay minerals were observed within the range of 3° to 20°, 2 theta value indicated the presence of clay minerals in

these sediments. To determine accurately the clay mineral types, heat treatment and glycolation method will be applied to separate and identify the presence of each clay minerals.

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1.70 Trace Element Geochemistry of Sediments of the Andhamanik River Channels

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Kuakata is one of the most popular tourist spots in Bangladesh. Andarmanik sediment load has great impact on the coastal area of Kuakata beach area. River sediment has important role to transfer the metals to the aquatic environment. So, 11 sediment samples were collected from the Andarmanik river to determine trace element concentration for geochemical evaluation. Samples were preserved and prepared to determine trace element by ED-XRF techniques. After getting the result, data will be analyzed and assess to understand ecological risk adopting several risk assessment codes. The work is in progress.

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1.71 Geochemical and Mineralogical Evaluation of the Sediment of Meghna Estuary

S. Hossain; J. Maoya*; T. Hamid*; K. M. Mamun; J. Kabir; S. Akter; K. Hossain; H.N. Das; S.M. Haque; Y. N. Jolly

Meghna Estuary is known to be one of the most important location for aquatic environment. As, sediment play key role to transfer metals to the environment, it is necessary to investigate detailed chemistry and mineralogy of the river sediment. The objective of this study is to understand detail mineralogy and geochemistry and its impact on the aquatic environment. Total 13 sediment samples were collected from the Meghna estuary at an definite interval. Samples were preserved and prepared to powdered form for analysis through ED-XRF and XRD techniques. Detail ecological risk assessment will be determined applying different risk assessment code. The work is under progress.

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Clinical Chemistry

1.72 Association of Environmental Toxic Metals with Renal and Cardio-metabolic Risk Factors in a Rural Population of Bangladesh

S. B. Quraishi, S. R. Khan and S. M. Salauddin*

Rural villagers are often seen to suffer from various diseases including kidney diseases, diabetics, hypertension at premature age. The possibility is that the continuous contamination of our environment by various heavy metals has a strong role there. The aim of this study was to assess the level of toxic metals and to observe their association with renal and cardio-metabolic risk factors in a rural population of Bangladesh. The current investigation has been based on the analysis of Pb and Cd in human excretion like urine, body fluid e.g. blood serum and the presence of same elements in the components of environment e.g water, in which the target persons reside by. Until now 203 urine samples and 9 water samples has been analyzed for the presence of Pb and Cd with atomic absorption spectroscopy (AAS). In addition, 154 blood serum has been collected and completed the analysis. The level of Pb and Cdf in water were found within the permissible level but higher Pb and Cd level in blood serum may be due to sorrounding environmental contamination.

*National Institute of Kidney Diseases and Urology, Dhaka

1.73 Levels of Essential and Toxic Elements in Serum of Patients with Chronic Kidney Disease: A Study from an Urban Renal Center in a Developing Country

S.B Quraishi, S. R. Khan and A. Anwar*

Deficiencies of essential elements and excesses of potentially toxic elements are common in patients with chronic kidney disease (CKD).In developing nations like Bangladesh; malnutrition is frequent in both the general populace and CKD patients. In addition, considerable amounts of toxic substances have been identified in the soil, water, and green vegetables. There was no study to assess such elements in CKD serum samples. The purpose of this study was to determine the presence of Zinc and Magnesium as essential elements and Lead and Cadmium as toxic components in the serum of CKD patients. This cross-sectional study, which included 87 CKD patients with prior diagnoses, was conducted at the department of nephrology, National Institute of Kidney Diseases & Urology (NIKDU). In fasting serum samples, the levels of Zinc, Magnesium,

Lead, and Cadmium were determined by Varian Atomic Absorption Spectrometer using flame atomic absorption spectrometry (F-AAS) and graphite-furnace atomic absorption spectrometry (GF-AAS), respectively. Results: 35% of study participants had end-stage renal disease (ESKD) on dialysis, whereas 29% had stage 4 CKD. The study populations had a little male majority (53%) and a mean age (SD) of 48.9 (12.3) years. All stages of CKD, with the exception of participants from stage 1-3 CKD, had low median blood levels of Magnesium and Zinc. In more advanced stages of CKD, Zinc and Magnesium levels also trended downward. On the other hand, stage 5 CKD with or without dialysis showed a statistically significant increase in serum Lead and Cadmium levels, with normal Cadmium levels in stages 1-3 CKD being the exception.

*Department of Nephrology National Institute of Kidney Diseases and Urology, Dhaka

1.74 Arsenic measurement: A Glimpse of Arsenicosis Patient in Bangladesh

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

To help diagnose Arsenicosis patients by measuring the level of arsenic in scalp hair using EDXRF technique, this eventually allows having a glimpse of arsenicosis patients in Bangladesh. As part of its commitment, a total of 131 hair samples, where the number of males is slightly ahead of females, have been analysed using EDXRF technique. A significant number, predominantly from the age group of 41-50 yrs, have been found with arsenic more than the normal level (3.0 mg/kg). The highest value derived from a 50 year old man from Noakhali was 14.53 mg/kg. It's an analytical service provided on regular basis

2. Seminar/Symposium/Conference/Workshop/Meeting Attended

Name of the person	Title of the event	Organizer	Date	Place
Dr. Shamshad B. Quraishi	1st International Science Conference for Women (WSTC) -2023	Dhaka Nanomaterials Group	15-16 February 2023	Pan Pacific Sonargaon
Dr. Yeasmin Nahar Jolly	BCSIR Congress-2022	BCSIR	01-03 December 2022	BCSIR & BRiCM
	National Conference on Physics-2023	BPS	09 – 11 March 2023	Jahangirnagar University
Md. Jamiul Kabir	BCSIR Congress-2022	BCSIR	01-03 December 2022	BCSIR & BRiCM
	National Conference on Physics-2023	BPS	09 – 11 March 2023	Jahangirnagar University
Dr. Shirin Akter	BCSIR Congress-2022	BCSIR	01-03 December 2022	BCSIR & BRiCM
	National Conference on Physics-2023	BPS	09 – 11 March 2023	Jahangirnagar University
K. M. Mamun	BCSIR Congress-2022	BCSIR	01-03 December 2022	BCSIR & BRiCM
	National Conference on Physics-2023	BPS	09 – 11 March 2023	Jahangirnagar University
Md. Safiur Rahman	BCSIR Congress-2022	BCSIR	01-03 December 2022	BCSIR & BRiCM
	National Conference on Physics-2023	BPS	09 – 11 March 2023	Jahangirnagar University
Dr. T. R. Choudhury	Bangladesh Council of Scientific and Industrial Research (BCSIR) Congress - 2022	BCSIR	01-03 December 2022	Dhaka
	National Conference on Physics-2023	BPS	9-11 March 2023	Jahangirnagar University, Savar, Dhaka

Name of the person	Title of the event	Organizer	Date	Place
	1 st International Conference on Nano-bio and Advanced Materials Engineering (NAME 2023)	Jeshore University of Science and Technology	7-8 January 2023	Cox's Bazar, Bangladesh
	International Conclave on Materials, Energy & Climate	DU	19-20 December 2022	University of Dhaka
Dr. Sushmita Hossain	1st International Science Conference for Women (WSTC) -2023	Dhaka Nanomaterials Group	15-16 February 2023	Pan Pacific Sonargaon
	International Conference on Environmental Protection for Sustainable Development (ICEPSD) 2022	DU	2-4 September 2022	Dhaka
A. R. M. Tareq	International Conference on Environmental Protection for Sustainable Development (ICEPSD-2022)	BAL	2-4 September 2022	DU
	International Conference on Frontier in Sciences (ICFS-2022)	BUET	11-12 November 2022	BUET
	BCSIR Congress-2022	BCSIR	1-3 December 2022	BCSIR
	Conference of Bangladesh Crystallographic Association	BCA	8-9 December 2022	BUET
	International Conclave on Materials, Energy & Climate	DU	19-20 December 2022	DU
	National Conference on Physics	BPS	9-11 March, 2023	JU
Ronita Sultana	International Conference on Environmental Protection for Sustainable Development (ICEPSD-2022)	BAL	2-4 September 2022	DU
	International Conference on Frontier in Sciences (ICFS-2022)	BUET	11-12 November 2022	BUET
	BCSIR Congress-2022	BCSIR	1-3 December 2022	BCSIR
	Conference of Bangladesh Crystallographic Association	BCA	8-9 December 2022	BUET
	International Conclave on Materials, Energy & Climate	DU	19-20 December 2022	DU
	National Conference on Physics	BPS	9-11 March, 2023	JU
Md. Fahim. Ehsan	International Conference on Environmental Protection for Sustainable Development (ICEPSD-2022)	BAL	2-4 September 2022	DU
	International Conference on Frontier in Sciences (ICFS-2022)	BUET	11-12 November 2022	BUET
	BCSIR Congress-2022	BCSIR	1-3 December 2022	BCSIR
	Conference of Bangladesh Crystallographic Association	BCA	8-9 December 2022	BUET
	International Conclave on Materials, Energy & Climate	DU	19-20 December 2022	DU
	National Conference on Physics	BPS	9-11 March 2023	JU

3. Collaboration Work(s)

This Division has collaboration work with the member state across Asia-Pacific region under IAEA/RCA framework. The collaboration area is given below:

1. IAEA/RCA RAS-7031: Assessing the Vulnerability of Coastal Landscapes and Ecosystems to Sea-Level Rise and Climate Change (RCA)
2. IAEA/RCA RAS-7037: Enhancing Wetland Management and Sustainable Conservation Planning (RCA)
3. IAEA/TC RAS-1030: “Using Radioisotope Techniques and Computational Fluid Dynamics Simulation for Troubleshooting and Optimizing of Industrial Processes”

4. Special Allocation (Grant) MOST Project

1. MOST R & D Grant 2022-2023-(Reg-8) of Ministry of Science & Technology entitled “Synthesis of ZnO₂/MnO₂@TiO₂ porous nanomaterials synthesis for the efficient removal of radionuclide from aqueous solution”, (July 2022 to June 2023).
2. Special Allocation Grant Project MOST (MOST-SRG-225579) of Ministry of Science & Technology entitled “Synthesis of Silver Nanoparticles by using Momordica charantia Extracts and Their Antibacterial Application Viability”, (July 2021 to June 2023).

5. Service Rendered

Routine Analytical Services provided in the year of 2022-2023

Sl. No.	Name of Organizations	Type of sample	No. of samples	Revenue income (Tk)
1	Patients from different hospitals and clinics	Urine	1507	1,179,200.00
2	Patients from different hospitals and clinics	Serum	15	21,000.00
3	Bangladesh Food Safety Authority (BFSA)	Milk	9	18,000.00
4	Bangladesh Food Safety Authority (BFSA)	Poultry Feed	43	86,000.00
5	Taspiya Hamid, BSMR Maritime University	Fish	5	20,000.00
6	Md. Mahmudul Hasan	Lime	1	4,500.00
7	SanjidaSafaTithi	Municipal Waste	3	9,000.00
8	Him Enterpirse	Sulfuric Acid	1	18,000.00
9	Crescent Chemicals Ltd	Sulfuric Acid	1	18,500.00
10	Dr. Mohammad Afzalur Rashid	Water	1	1,500.00
11	B K Sojib	Ash	3	6,000.00
12	Ummay Salma	Ash	2	12,000.00
13	Ministry of Foreign Affairs	Gold	2	5,000.00
14	Ministry of Foreign Affairs	Gold	2	5,000.00
15	Ministry of Public Administration	Gold	31	77,500.00
16	Ministry of Women and Children Affairs	Gold	5	12,500.00
17	Ministry of Fisheries and Livestock	Gold, Silver	16	36,000.00
18	Ministry of Women and Children Affairs	Gold	5	12,500.00
19	University of Dhaka	Gold	2	5,000.00
20	University of Dhaka	Gold	1	2,500.00
21	University of Dhaka	Gold	2	5,000.00
22	Ministry of Public Administration	Gold	4	10,000.00
23	Ministry Agriculture	Gold, Silver	19	39,500.00

Sl. No.	Name of Organizations	Type of sample	No. of samples	Revenue income (Tk)
24	Bangladesh Shilpakala Academy, Ministry of Cultural Affairs	Gold, Silver	40	90,000.00
25	BijoyEkattor Hall, University of Dhaka	Gold	2	5,000.00
26	Ministry of Local Government, Rural Development & Cooperatives	Gold	11	27,500.00
27	Faculty of Engineering and Technology, University of Dhaka	Gold	2	5000.00
28	Ministry of Posts, Telecommunications and Information Technology	Gold	22	55,000.00
29	Ministry of Foreign Affairs	Gold	1	2,500.00
30	University of Dhaka	Gold	171	95,000.00
31	University of Dhaka	Gold	171	114700.00
32	Ministry of Women and Children Affairs	Gold	5	12,500.00
33	Export Promotion Bureau	Gold, Silver	54	120,540.00
34	Ministry of Women and Children Affairs	Gold	5	12,500.00
35	Shokh Jewellers	Gold	1	2,500.00
36	Ruqayyah Hall, University of Dhaka	Gold	2	5,000/-
37	Bangladesh Shilpakala Academy, Ministry of Cultural Affairs	Gold, Silver	6	9,000.00
38	Bangladesh Bank	Silver	2	4,000.00
39	Shokh Jewellers	Gold	2	5,000.00
40	Ministry of Youth and Sports	Gold, Silver	80	180,000.00
41	Ministry of Social Welfare	Gold	8	20,000.00
42	Bangladesh Shilpakala Academy, Ministry of Cultural Affairs	Gold	1	2,500.00
43	Ministry of Cultural Affairs	Gold	21	52,500.00
44	International Mother Language Institute	Gold, Silver	10	11,800.00
45	Bangladesh Bank	Silver	1	2,000.00
46	Ministry of Information and Broadcasting	Gold	35	87,500.00
47	Cabinet Division	Gold	11	27,500.00
48	University of Dhaka	Gold	4	10,000.00
49	Export Promotion Bureau	Gold, Silver	54	122,390.00
50	Amin Jewellers	Gold	4	10,000.00
51	University of Dhaka	Gold	3	7,500.00
52	Amin Jewellers	Gold	1	2,500.00
53	Bangladesh Tea Board, Chattogram	Gold	7	17,500.00
54	Different Hospitals and Clinics	As (Arsenic)	118	111,000.00
55	Chittagong University of Engineering and Technology	Ti, Cr, Mn, Fe, Co, Ni, Cu, Zn, As, Se, Rb, Sr, Y, Zr, Pb	2	2,300.00
56	Department of Archaeology, Jahangirnagar University	Ag, Cu, Se, Rb	26	26,000.00
Total =			2563	2862,930.00

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 been contributed in 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.

Program

The Division has played a significant role in the development of indigenous capability for design and development of instrumentation and its maintenance at AECD. Main activities of the Division are in the following areas:

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

1. Research and Development Work(s)

1.1 Design and Development of IoT based Nuclear Radiation Monitoring System

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

Objective: With accelerating demand, nuclear technology is being more widely used in the power sector, medical treatment, industrial sector, educational sector and research field. It is to inform that the first nuclear power plant of Bangladesh is going to be operational very soon. Moreover, there are other nuclear facilities in the country like research reactors, nuclear medicine centers etc. As nuclear technology cannot be avoided, it is essential to take precautionary measures to protect radiation workers from being exposed to unwanted radiation levels. Hence, increased worker and longer time duration is required to do a hazardous task. To mitigate the problem, it is essential to monitor nuclear radiation remotely that can assist in regular basis activities like area monitoring, source handling, inspection and maintenance as well as post accidental recovery. The objective of this work is to design an IoT based system for acquiring nuclear radiation data from the environment as well as monitoring and storing it remotely using web-based user interface

Current progress: In this work, a nuclear radiation monitoring system is presented that is employed for acquiring and storing environmental radiation data around the nuclear facilities. 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. A prototype of the proposed system has been developed. It will be also helpful to ensure safety of the human workers from unwanted radiation exposure, by assisting them with remote monitoring of radiation levels of hazardous locations where human presence should be limited.

1.2 Development of a Dielectric Barrier Discharge System

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

Objective: Dielectric Barrier Discharge (DBD) is used in a wide range of interesting industrial applications, including ozone and UV generation, air and wastewater treatment, sterilization of packaging and food, as well as surface treatment of materials. The most important characteristic of DBD is the non-thermal atmospheric pressure plasma, which is significantly influenced by the power delivered from the power supply. The objective of this work is to develop a DBD system using a high voltage pulsed power supply (HVPPS) for atmospheric pressure cold plasma discharge applications as like surface treatment of polymer materials.

Current progress: In this study, a DBD system is proposed that is basically designed for atmospheric pressure plasma discharge applications. A high voltage pulsed power supply (HVPPS) is employed to deliver the power

for DBD. The HVPPS mainly consists of a high voltage DC supply connected to an energy storage capacitor employing as primary energy source, a low voltage signal generator associated with driving circuits for generating the trigger signals of the power switches, and a pulse transformer for stepping up the primary voltage to the higher value and delivering the pulsed power to the load. The HVPPS was employed to carry out DBD experiments in an atmospheric pressure using argon (Ar) gas. It was observed that HVPPS could usefully generate DBD by using sinusoidal pulse trains. The sinusoidal pulse parameters could also be varied in such a way that the output peak voltage could be adjusted by varying the dc input voltage as well as both the frequency and pulse width could be tuned by altering the triggering signals to the power switches. The experimental results reveal that the developed DBD system can generate atmospheric pressure cold plasma, which can be suitable for the surface treatment of materials.

*Graduate School of Engineering, Kochi University of Technology, Kochi, Japan.

1.3 Walking Speed Classification from Marker-Free Video Images in Two-Dimension Using Optimum Data and a Deep Learning Method

M. A. A. Mamun, T. Sikandar* and N. U. Ahamed**

Objective: The aim of this study was to investigate the optimal combination of ratio-based body measurements needed for presenting potential information to define and predict a walk pattern in terms of speed with high classification accuracy using a deep learning-based walking speed classification model.

Current progress: Walking speed is considered a reliable assessment tool for any movement-related functional activities of an individual (i.e., patients and healthy controls) by caregivers and clinicians. Traditional video surveillance gait monitoring in clinics and aged care homes may employ modern artificial intelligence techniques to utilize walking speed as a screening indicator of various physical outcomes or accidents in individuals. Specifically, ratio-based body measurements of walking individuals are extracted from marker-free and two-dimensional video images to create a walk pattern suitable for walking speed classification using deep learning based artificial intelligence techniques. However, the development of successful and highly predictive deep learning architecture depends on the optimal use of extracted data because redundant data may overburden the deep learning architecture and hinder the classification performance. The performance of different combinations of five ratio-based body measurements was evaluated through a correlation analysis and a deep learning-based walking speed classification test. The results show that a combination of three ratio-based body measurements can potentially define and predict a walk pattern in terms of speed with classification accuracies greater than 92% using a bidirectional long short-term memory deep learning method.

*Faculty of Electrical and Electronics Engineering, University of Malaysia Pahang, Pekan, Malaysia

**Department of Radiation Oncology, School of Medicine, University of Pittsburgh, Pittsburgh, USA

1.4 Fractal Pattern Identification from Wearable Inertial and Electromyographic Signals Data During Walking

M. A. A. Mamun, S. A. M. M. Rahman* and M. A. Ali**

Objective: Acceleration, angular velocity and electromyographic (EMG) signal at the lower limb muscles, specially over both leg's Tibialis Anterior muscles are highly non-stationary, even if no perturbing influences can be identified during walking at any speed. The objective of this work is to analyze the fractal dynamics (i.e., complexity of gait time series) in the walking gait time series of four types of signals obtained from wearable sensors.

Current progress: The four types of signals obtained from wearable sensors such as IMUs (inertial measurement units), i.e., accelerometer signals which represents the acceleration experienced by the body, gyroscope signals which is the angular velocity, and magnetometer signals which is magnetic field vector, and Electromyographic (EMG) signal from both leg's Tibialis Anterior muscles were investigated. Gait time series from twenty-two healthy participants were analyzed while they performed walking at their comfortable speed. The scaling exponents (i.e., α -values) of the gait dynamics were accomplished by evaluating their fluctuation through detrended fluctuation analysis (DFA), which is most common and widely used non-linear technique for any non-stationary time series. DFA (the scaling exponents α) results established an anti-persistent in EMG and acceleration signal, less persistent pattern in angular velocity and persistent (i.e., long-range or fractal-like

correlations) in magnetometer signal. This fractal complexity or noise patterns obtained from the EMG and inertial signals might provide new approaches for assessing and forecasting sudden injury risk during walking.

*Department of Software Engineering, Daffodil International University (DIU), Dhaka, Bangladesh

**Department of Computer Science, American International University-Bangladesh (AIUB), Dhaka, Bangladesh

1.5 An Automated Indoor Hydroponics System for Analyzing Various Environmental and Nutritional Factors Affecting Plants Growth

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

Objective: Hydroponics is a soilless crops growing method with the benefits of controlling the environment and nutrients, conserving water, and reducing labor. This method of growing crops is capable of providing high quality, healthy, fresh, residue free vegetables and fruits locally. In addition, the fact that no soil is needed allows hydroponic system to expand vertically (also known as vertical farming) to save space. Various hydroponics cultivation methods (Drip system, Wick system, DWC, NFT etc.) are available for indoor, outdoor, poly house etc. farming. Aim of this work is to design a prototype automated system for analyzing various environmental and nutritional factors affecting plants growth to establish a sustainable indoor hydroponics farming technique.

Current progress: Parameters that control the growth of plants in hydroponics system are nutrients, water, electrical conductivity (EC), TDS, pH, grow light, oxygen, carbon dioxide, environmental temperature and relative humidity, water temperature etc. In hydroponics, it is possible to increase production rate (2X, 3X and some cases more) with reducing time than traditional soil base farming, with proper control of the above mentioned growth parameters. In this work, an automated indoor hydroponics system is proposed for analyzing various growth parameters in order to establish a cost-effective suitable growing environment for a particular crop. As a part of the proposed work, SHT-71 temperature and relative humidity sensor is interfaced with a microcontroller to monitor and control environmental temperature and humidity. Future work is to interface necessary sensors with microcontroller for monitoring and controlling of other growth parameters (EC, TDS, pH, grow light etc.).

1.6 A Study on Machine Learning Algorithms for Robot Path Planning

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

Objective: A robotic system needs many types of parameters functioning properly. Path planning is one of the basic and necessary functions for an intelligent mobile robot. Path planning aims at to find out the path between beginning and destination in work area by approaches like shortest distance or shortest time, avoid obstacles etc. Traditionally designers designed their systems with trial-and-error based way. Now a days it is possible to make the robot more robust by incorporating machine learning algorithm in case of path planning. Aim of the study is to get familiar with the algorithms and their functions.

Current progress: In this study, principles of various machine learning algorithms for path planning have been discussed. These include supervised learning algorithms, reinforcement learning algorithms, policy gradient algorithms etc. Under these categories there are several models like as MSVM, CNN, Q-learning, DPG etc. which have been discussed to provide the researchers a brief understanding about advantages, shortcomings, future scopes of work, connections and new ideas for path planning algorithms for more accurate results in new work environment. The work is ongoing.

1.7 Design and Development of Air Pollution Monitoring System Using MQ135 Sensor

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

Objective: Air pollution is the presence of extra unwanted biological molecules, particulates or other harmful things in the earth's atmosphere. The level of air pollution has increased with time by a lot of factors like the increase in population, increased vehicle use, industrialization and urbanization. Air pollution poses a threat to the ecosystem and the quality of life on the planet. It is also a major cause of infections, allergies, and eventually reasons of death for some people. To provide adequate environmental and health protection, an effective air quality monitoring system is a necessary instrument. The aim of this research work is to design and develop an inexpensive air pollution monitoring system in which we will monitor the Air Quality.

Current progress: In this work, we have used Arduino UNO, MQ-135 air quality sensor, LCD, breadboard, jumper wires, and potentiometer. The Arduino Uno is a modern microcontroller board based on the

ATmega328P. It is simply related to a computer by a USB link or power. Using jumper wires the MQ135 gas sensor unit is linked to the Arduino Uno board. The MQ135 gasoline sensor can detect a huge variety of the gases like NH₃, alcohol, benzene steam, CO₂ and smoke and other diverse dangerous gases which are present in the air. The sensors' analog pin is related to the analog pin 0 and the digital pin to digital 8 on the Arduino board. When we give power supply to this device then it starts working, which means that after receiving power supply 5v the MQ 135 sensor starts detecting the quality of air within a limited range. After that, it will send information to LCD about the level of pollution in ppm. This is an ongoing work.

1.8 Heart Disease Prediction using Machine Learning Algorithms

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

Objective: Heart disease and various heart disorders have become a serious death threat globally. A precise diagnosis is necessary to reduce this mortality and exploring the potential of machine learning algorithms on digitized patient data can be very effective in this regard. This study aims to find the most appropriate machine learning algorithms for this type of diagnosis that can be used by healthcare institutions for the prediction of heart disease.

Current progress: A standard dataset containing patients' information is used in this research. Patients' information is processed and the diagnosis system is designed using several machine learning algorithms, such as decision tree, K-nearest neighbor, random forest, support vector machine, and logistic regression. Several performance metrics, such as accuracy score, sensitivity, specificity, and F1- score are estimated to assess their effectiveness in this application. Results reveal that decision tree, K-nearest neighbor, and random forest algorithms obtained 100% accuracy with 100% specificity and sensitivity. Moreover, patients' information is analyzed and key features are identified based on relative importance scores as used by different machine learning algorithms. Feature importance scores, as calculated by best-performing algorithms are consistent with clinical diagnosis procedures followed by experts. This study will help clinical people and healthcare institutions predict and diagnose heart disease well.

1.9 Early Stroke Prediction using Supervised Machine Learning Algorithms

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

Objective: Stroke is a disease that affects the arteries leading to and within the brain. According to the World Health Organization (WHO), stroke is the 3rd leading cause of death and disability globally. But 80 percent of strokes are preventable. So, the main objective of our work is an early prediction of stroke to take prevention.

Current progress: A Stroke is a health condition that causes damage by tearing the blood vessels in the brain. It can also happen when the passage of blood and other nutrients to the brain is interrupted. Stroke is the third most common cause of death and disability worldwide, according to the World Health Organization (WHO). Different machine learning algorithms can be developed to forecast the likelihood of a brain stroke. Supervised machine learning methods such as Logistic Regression, Decision Tree Classification, Random Forest Classification, K-Nearest Neighbors, Ada-Boost, and Support Vector Machine Classification will be used to train different alternative models for precise prediction. It is an ongoing work.

2. Service Rendered

2.1. Repair and Maintenance of Electronic Instruments and Computers

During this period, various scientific, medical, nuclear and analytical instruments have been repaired. The major instruments include TLD Reader, 24 volt DC power supply and Vortex mixer. This division also provides maintenance of computer, intercom and CCTV system of AECD successfully. The Intercom system contains Digital PBX-Board, Panasonic 16SLC having 96 lines and Panasonic D1232 having 16 lines.

Table: Type and number of instruments are repaired

Sl.	Type of the instruments	Name of the user	Quantity
01.	Scientific, Nuclear and Analytical	AECD	04
02.	Computer (System Unit with software installation)	AECD	25
03.	UPS	AECD	02
04.	Intercom System (Line & Set)	AECD	10

3. Manpower Development and Training Programme Arranged

Title of the event	Date	Place	No. of participant
A three months Industrial Attachment Training program	10/10/2022 - 10/01/2023	Electronics Division, AEC, Dhaka	09

4. Seminar/Symposium/Conference/Workshop Attended

Name of the participant	Title of the event	Organizer	Date	Place
Mohaimina Begum	International Conference on Electronics and Informatics 2022	BEIS	26-28 January 2023	AECD
	1 st International Dhaka Science Conference for Women-WSTC 2023	Dhaka Nano Materials Group and ISP Uppsala University, Sweden	15-16 February 2023	OASIS, Hotel Pan Pacific Sonargaon, Dhaka
Shahana Sultana	International Conference on Electronics and Informatics 2022	BEIS	26-28 January 2023	AECD
Dr. Md. Abdullah Al Mamun	International Conference on Electronics and Informatics 2022	BEIS	26-28 January 2023	AECD
M. Atiar Rahman	International Conference on Electronics and Informatics 2022	BEIS	26-28 January 2023	AECD
Sabiha Sattar	International Conference on Electronics and Informatics 2022	BEIS	26-28 January 2023	AECD
	1 st International Dhaka Science Conference for Women-WSTC 2023	Dhaka Nano Materials Group and ISP Uppsala University, Sweden	15-16 February 2023	OASIS, Hotel Pan Pacific Sonargaon, Dhaka
Mist Toma Khatun	International Conference on Electronics and Informatics 2022	BEIS	26-28 January 2023	AECD
Aklima Begum	International Conference on Electronics and Informatics 2022	BEIS	26-28 January 2023	AECD
	1 st International Dhaka Science Conference for Women-WSTC 2023	Dhaka Nano Materials Group and ISP Uppsala University, Sweden	15-16 February 2023	OASIS, Hotel Pan Pacific Sonargaon, Dhaka

5. Collaboration Work

This division is involved with the collaboration research works with different National & International universities.

Experimental Physics Division, AECD**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.

Program

To implement the objectives, the following working schedule has been adopted:

- Development of device-grade solar energy materials, preferably in thin film form, for photovoltaic and thermo-photovoltaic applications.
- Fabrication of photovoltaic and photo thermal devices.
- Studies of the fundamental properties of the solid-state materials.
- Studies of nuclear reactions and, detection and characterization of nuclear radiation.
- Studies of the Synthesis and characterization of Nano particles
- Preparation and characterization of SnS_2 , SnS , Fe doped SnS thin film deposited by spin coating.
- Preparation and characterization of CuGaSe_2 , ZnSe , Al doped ZnSe , Mn doped ZnSe , Ag doped ZnSe , Zn doped CdTe , CdTe thin films by thermal evaporation
- Preparation and characterization of Cr doped ZnS , CuO , ZnS , CdSe , CdS Thin film deposited and CdS , SnS_2 Solution, ZnO Nano particle synthesized by chemical bath deposition.
- Study of photo detector materials of thin films.
- Study of p-type absorbs layers of CdTe thin films.
- Nuclear detector thin film materials study.

Activities

1. Research and Development

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

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

Current progress: 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 Thin Films using thermal evaporation technique

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

Objective: Analysis of optical properties of ZnSe thin film

Current progress: Thin films of Zinc Selenide (ZnSe) have been deposited onto an ultrasonically cleaned glass substrate by sequential and successive thermal evaporation method. The films thickness was 500 nm having the fixed thermal annealing temperature for duration 1 hour. The optical properties of the films were investigated by UV-Vis NIR spectroscopy analysis the quality of the films has been ascertained by their optical properties in the photon wavelength 300 nm to 2500 nm.

1.3. Deposition and Characterization of SnS 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

Objective: To observe the SnS thin films and also measure the parameters of the samples.

Current progress: Tin di-sulfide (SnS_2) 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 $A_T = 100^\circ\text{C}$, 400°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. Analysis of the parameters is going on.

1.4. Deposition and Characterization of Fe doped SnS thin Films by Spin Coating Deposition Technique

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

Objective: To observe the Fe doped SnS_2 thin films and also measure the parameters of the samples.

Current progress: Tin di-sulfide (SnS_2) thin films were synthesized by Spin coating method. SnS and Fe (0%, 5%, 7%, 9%) doped SnS_2 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°C /1hour. 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. Preparation and Characterization of the Structural, Optical, Morphological Characterization of SnS_2 Thin Films Deposited by Spin Coating Method

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

Objective: To observe the SnS_2 thin film and also measure the parameters of this samples.

Current progress: SnS_2 thin films with constant speed and different deposition time were prepared by simple and relatively easy spin coating method. Stannic chloride pentahydrate ($\text{Cl}_4\text{H}_{10}\text{O}_5\text{Sn}$), Thioacetamide were used as the precursors whereas Ammonium chloride, Distilled water and Triethylamine worked as solvent and stabilizer respectively. Solutions of all the samples were prepared using chemical bath deposition method. All the samples prepared at 1000, 1500 and 2000 rpm spin speed with varied deposition time such as 60s, 90s and 120s were annealed at room temperature for 1 hour. The thicknesses of all samples were measured and were found near 114 nm. The optical parameters such as transmittance, absorption coefficient and energy band gap of the films were investigated by UV-VIS-NIR. The optical measurement of transmittance, absorbance and band gap of these films were determined over 310nm to 2500nm using UV-Vis Spectrometry at room temperature. These films can be used as one of the important components for solar cell and electronic applications. One research article is published on this work.

1.6. Preparation and Characterization of the Structural, Optical, Morphological Characterization of ZnO Thin Films Deposited by Spin Coating Method

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

Objective: To observe the ZnO thin film and also measure the parameters of these samples.

Current progress: ZnO thin films with constant speed and different deposition time were prepared by simple and relatively easy spin coating method. polyethylene glycol was used as the precursors whereas respectively. Solutions of all the samples were prepared using spin coating deposition method. All the samples prepared at 3000 rpm spin speed with varied deposition time such as 30s annealed at 600°C temperature for 1 minute. The thicknesses of all samples were measured. The optical parameters such as transmittance, absorption coefficient and energy band gap of the films were investigated by UV-VIS-NIR. The optical measurement of transmittance, absorbance and band gap of these films were determined over 310nm to 2500nm using UV-Vis Spectrometry at room temperature. These films can be used as one of the important components for solar cell and electronic applications. AFM Measurement also done and Analysis of the parameters are going on.

1.7. Optical Characterization of the Radiation Effect on CdTe Thin Film Deposited by Thermal Evaporation Method

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

Objective: Analysis of structural, optical and electrical properties of CdTe thin film.

Current progress: CdTe thin films of 50 nm (30 nm at 300°C S_T and 20 nm at 200°C S_T), 100nm (60 nm at 300°C S_T and 40 nm at 200°C S_T) and 200 nm (120 nm at 300°C S_T and 40 nm at 80°C S_T) have been deposited on the glass substrate at fixed annealing temperature 100°C for 60 min by thermal evaporation method and the gamma radiation effect on their optical properties has been investigated. Transmittance and reflectance have been measured in the region from 400 nm to 1300 nm and were used to evaluate the optical parameters (Transmittance, reflectance, absorption coefficient, extinction coefficient, refractive index) and the band gap energy for CdTe thin films before and after gamma radiation (50 kGy and 100 KGy of Cobalt 60 Source). Optical band gap and the transmittance were found to decrease with the increase of dose of gamma radiation for all the films.

1.8. Biosynthesis of Silver Nano Particle Using Cell Based Chip.

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

Objective:

- AgNP formation mammalian cell cultured in AgNO₃ supplemented growth medium
- Physical investigation and elemental confirmation of the synthesized AgNP
- Evaluation of the antibacterial activity of synthesized AgNP at the laboratory level as well as small scale field levels.

Current Progress: The proposed program will develop a new antimicrobial agent capable of combating the recently focused Antimicrobial resistance (AMR) issue. This will be achieved with the intracellular formation of AgNP using biocompatible materials and eco-friendly processes and hence comply with the green technology. The developed AgNP will be used as an antimicrobial agent instead of the currently practiced antibiotics, thereby overcoming the AMR issues. Besides, the proposed green fabrication process of the intracellular formed AgNP is ensuring their host compatibility. X-ray diffraction pattern (XRD) are used to study the crystallinity of the nano particles. Optical properties were characterized by UV-VIS-NIR spectroscopy.

1.9. 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

Objective: Analysis of structural, optical, elemental and electrical properties of Mn doped ZnSe thin films.

Current progress: 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.

1.10 Synthesis of Ag doped ZnSe Thin Film by Thermal Evaporation Method

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

Objective: Analysis of structural, optical, elemental and electrical properties of Ag doped ZnSe thin films.

Current progress: 1%, 1.5%, 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 $A_T = 300^\circ\text{C}$ 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 AND Morphological measurement was observed by FTIR and SEM. ZnSe films thickness were calculated and synthesis and Analysis of the parameters are going on.

1.11 Preparation and Characterization of CuO Thin Film using Chemical Bath Deposition Technique (CBD)

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

Objective: Analysis of structural, optical, elemental and electrical properties of CuO thin films.

Current Progress: 1.5972g copper acetate was added in 40mL isopropanol to prepare 0.2M solution. the solution was stirred for 15 min at room temperature (22° C). Then 20mL MEA was added to the solution to stabilize. Furthermore, the solution was stirred for 45 min at 70°C. Then a ready glass substrate was dipped in to the solution for 1 hour at 70°C. After that the substrates was annealed for 15 min at 100°C.

1.12 Investigation of the Effect of the Annealing Temperature on CdS Nano particles Synthesized by Chemical Precipitation Technique

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

Objective: To observe the CdS nano particles also measure the parameters of the samples.

Current progress: 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 CdS nano particles 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 are 73.30 nm, 61.91nm and 88.81 nm 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. One research article is published on this work.

1.13 Effects of Gamma Irradiation on Structural and Optical Properties of BaTi_{0.5}Fe_{0.5}O₃ Composite Material

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

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

Current progress: 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. Characterization and Analysis of the parameters are going on.

1.14 Synthesis and Characterization of SnS₂ thin Films by CBD Technique

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

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

Current progress: Tin di-sulfide (SnS₂) thin films were synthesized by chemical precipitation method. SnS₂ thin films are deposited on glass substrate. Thin films were prepared at room temperature for 5 hours. & annealing temperature A_T = 100°C for 60 min. Annealing temperature significantly influenced crystallinity and surface roughness of the thin films in CBD method. These films may be a good candidate for suitable application in various optoelectronic devices. Analysis of the parameters is going on.

1.15 Study of the Optical Properties of Zn Doped CdTe Thin Film as a Nuclear Detector Material Deposited by Thermal Evaporation Method

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

Objective: To deposit and characterize the optical properties of Zn doped CdTe thin films as a nuclear detector material.

Current progress: Zinc doped Cadmium telluride, often known as CZT, is currently regarded as one of the most promising materials for use in photonic devices, optical sensors, radiation detection, etc using thermal

vacuum evaporation, a thin film of cadmium telluride (CdTe) was deposited on a glass substrate, and zinc metal was doped with varying chemical proportions. With the doping concentration being tweaked for various samples, the optical properties of CZT were studied in depth. UV-Vis-NIR spectrophotometry was used to determine and evaluate the optical properties, such as transmittance, reflectance, absorption co-efficient, extinction co-efficient, refractive index, etc., and the results were plotted and presented in tabulated form. The increase in doping concentration raises the total transmittance value in the NIR region while diminishing the visible spectrum's transmittance property. The reflectance data produced a pattern which corresponded to the transmittance trend. Visible region absorption was determined to be greater, making the films more appropriate for solar energy applications. When doping renders the film more transparent to near-infrared photons, the NIR spectrum absorbance drops. Density of the material gets higher as increase in doping percentage takes place, it directly influenced the refractive index and was found to be widened in terms of absolute refractive index of the film. Doping with Zn was observed to increase oscillatory behavior for both transmittance and reflectance properties, leading to peak shifting and the formation of new peaks in these optical characteristic graphs.

2. Manpower Development and Training Programme

Title of the event	Date	Place	No. of participant
Nuclear Engineering Training Program	13-24 November 2022	CUET	1

3. Seminar/Symposium/Conference/workshop/Meeting Attended

Name of the participant	Title of the event	Organizer	Date	Place
Dr. K.M.A. Hussain	National Conference on Physics 2023	BPS	9-11 March 2023	JU
	1st International Dhaka Science Conference for Women-2023	WSTS	15-16 February 2023	Hotel pan pacific Sonargaon
T. Faruque	National Conference on Physics 2023	BPS	9-11 March 2023	JU
	1st International Dhaka Science Conference for Women-2023	WSTS	15-16 February 2023	Hotel pan pacific Sonargaon
J. Parvin	National Conference on Physics 2023	BPS	9-11 March 2023	JU
	1st International Dhaka Science Conference for Women-2023	WSTS	15-16 February 2023	Hotel pan pacific Sonargaon
F. T. Z. Toma	National Conference on Physics 2023	BPS	9-11 March 2023	JU
	1st International Dhaka Science Conference for Women-2023	WSTS	15-16 February 2023	Hotel pan pacific Sonargaon

4. Collaboration Work(s)

4.1 Project Work (Ministry of Science and Technology)

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, EPD, AECD.

4.2 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

Health Physics Division, AECD

Objective

The objective of Health Physics Division is to protect life, property and environment from radiation hazard through: (i) Population exposure control (ii) Occupational exposure control and (iii) Radiation protection services. Radiation and radioactivity in environmental samples & imported/exportable foods (except Chittagong Port) are being monitored as per requirement of the NSRC rules 1997 and BAER Act-2012. This division is the only service provider of Individual Monitoring (IMS) of occupational workers throughout Bangladesh which is mandatory as per Bangladesh Atomic Energy Regulatory requirements. Health Physics Division is one of the Technical Supporting Organization (TSO) of ongoing Rooppur Nuclear Power Plant (RNPP).

Program

Environmental Radiation & Radioactivity Monitoring

- Measurement of background radiation levels throughout Bangladesh and assessment of population exposure.
- Analysis of different radionuclides in environmental and biological samples both qualitatively and quantitatively.
- Development and standardization of analytical methods for low level measurement of radioactivity in environmental samples.
- Measurement of environmental gamma dose by Thermo-luminescent Dosimeter.
- Estimation of radioactivity concentration in Naturally Occurring Radioactive Materials (NORM) samples of different gas fields.
- Measurement of environmental gamma doses by In-Situ method.
- Assessment of Gross Alpha and Gross Beta activity in environmental samples.
- Determination of the Radon concentration in environmental samples such as air, water, and soil.

Occupational Exposure Control

- Control of occupational exposure by monitoring individual radiation exposure and workplace monitoring throughout the country.
- Measurement of extremity doses of workers in Nuclear Medicine and Interventional Cardiology Department.

Quality Assurance Programme for Radioactivity Measurement

- Performance test of detecting system.
- Participation in the inter-laboratory inter-comparison exercise (Proficiency Test) in Asia Pacific Region organized by International Atomic Energy Agency (IAEA).

Quality Assurance Programme of Individual Monitoring System

- Performance test of TL Dosimeter system through routine test and calibration.
- Participation in the inter comparison program of individual radiation monitoring (regional and international).

Activities

1. Research and Development Work(s)

1.1 Survey of Background Radiation Levels throughout Bangladesh

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

Objective: To assess the external exposure of population due to natural and artificial radiation.

Current progress: 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 $(0.12 \text{ to } 0.23) \mu\text{Svh}^{-1}$. It is observed that there is no change in background radiation level from the data of previous years.

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

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

Objective: The objective of workplace monitoring is to protect occupational workers from ionizing radiation.

Current progress: 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 equipments 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 $(0.53 - 2.23) \mu\text{Svh}^{-1}$, $(0.27 - 0.43) \mu\text{Svh}^{-1}$, $(0.53 - 4.39) \mu\text{Svh}^{-1}$ and $(0.23-0.41) \mu\text{Svh}^{-1}$ respectively. The control panel of AFD, XRD room of MSD and EDXRF room of Chemistry division were found around background level. No major change in dose level was observed.

1.3. Measurement of Radioactivity in Rain Water

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

Objective: To determine the radionuclides and their concentration in rain water.

Current progress: During the reporting period, eleven 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 coupled with a digital spectrum analyzer (DSP^{ec}jr 2.0). The radioactivity range of ^{238}U series, ^{232}Th series and ^{40}K was within the acceptable limit. Artificial radionuclide was not found.

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

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

Objective: To monitor the level of radioactivity in different food samples imported from SAARC and other countries as a part of radioactivity monitoring surveillance program.

Current Progress: Total 30 (Thirty-five) 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.

1.5 The Evaluation of Radioactivity and Radiological Risks Arising from Samples of Soil, water, and Coal Gathered within the BCMCL, CRR and RNPP Vicinity

S. Yeasmin, M.M. Mahfuz Siraz, M.S. Rahman and S.K. Das*

Objective: The objective is to observe and assess the radioactivity levels and radiological hazards present in environmental samples (such as soil, water, and coal) obtained from the BCMCL, CRR (AERE), and RNPP areas.

Current progress: The ongoing work involves collecting a total of 121 environmental samples (soil, water and coal) from Barapukuria Coal Mining Company Limited (BCMCL), 100 environmental samples (soil and water) from Centre of Research Reactor (CRR), AERE and 100 environmental samples (soil and water) from RNPP area. The collection and processing of the samples followed the standard procedures outlined by the International Atomic Energy Agency (IAEA) guidelines. Once prepared, the samples will undergo measurement using a high-purity germanium (HPGe) detector with a relative efficiency of 30%. This work is currently in progress and aims to establish baseline data regarding the environmental background radiation in the vicinity of the RNPP, BCMCL and CRR.

*Department of Physics, Jagannath University, Dhaka.

1.6 A Study into Radionuclide Distribution Patterns in Environmental Specimens Collected from Chattogram Division

M.S. Alam*, M. M. M. Siraz, Md. Jafor Dewan* and S. Yeasmin

Objective: To monitor the level of radioactivity in 40 environmental samples collected from Chattogram division

Current progress: This study represents an investigation into the activity concentration of environmental samples at Chattogram division, Bangladesh. The analysis involved collecting 40 samples and evaluating them using an HPGe detector. The results from the sand samples indicate that the activity concentrations of ^{232}Th (averaging 31.0 ± 5.3 Bq/kg), ^{226}Ra (18.6 ± 2.8 Bq/kg), and ^{40}K (310.8 ± 41.5 Bq/kg) are consistent with those of regions worldwide and are within their respective world average values. The assessment of radiological hazards indicates that ionizing radiation levels do not pose a significant danger to individuals residing in homes constructed with sand.

*Department of Nuclear Engineering, University of Dhaka

1.7 Naturally Occurring Radioactive Material's Activity in Soil Samples Collected from Khulna Division

Jubair A.M.*, M. M. M. Siraz, Md. Jafor Dewan* and S. Yeasmin

Objective: To monitor the level of radioactivity in 35 soil samples collected from Khulna division

Current progress: Total 35 soil samples were collected from 7 different areas of Khulna Division, and the activity concentrations of radionuclides were determined by gamma-ray spectrometry using a high-purity germanium detector. The radiological hazard parameters, including radium equivalent activity, external and internal hazard indices, and the outdoor and indoor effective doses were evaluated based on the measured activity concentrations of the radionuclides. It was discovered that the activity concentrations of ^{226}Ra , ^{232}Th and ^{40}K fell within a range of 16-38 Bq/kg, 19-56 Bq/kg, and 260-610 Bq/kg. All hazard indices values were below the recommended limit.

*Department of Nuclear Engineering, University of Dhaka

1.8 Study on Outdoor Environmental Gamma Radiation of Paltan Thana by In-Situ Method

M.S. Rahman, M. S. Hossain*, S. Yeasmin, M.M.M. Siraz, S. Pervin, N. Sultana, S. Hossain, Z. Hossain and J. Islam*

Objective: To measure real-time environmental gamma radiation from natural and artificial radionuclides.

Current Progress: In-Situ Environmental gamma-ray dose rate was measured at 32 locations of Paltan Thana under Dhaka district 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 0.085-0.190 μ Sv/h with an average of 0.145 μ Sv/h. The annual effective dose of the population due to the environmental gamma radiation was also calculated and it was varied from 0.104–0.233 mSv.

*Department of Physics, Mawlana Bhashani Science and Technology University

1.9 Study on Outdoor Gamma Radiation of Mymensingh Medical College Hospital Campus by In-Situ Method

M.S. Rahman, M. A. Faisal*, S. Yeasmin, M.M.M. Siraz, S. Pervin, N. Sultana, S. Hossain, Z. Hossain and J. Islam*

Objective: 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.

Current Progress: In-Situ outdoor radiation was measured at 32 locations of Mymensingh 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 0.25-4.11 μ Sv/h with an average of 1.438 μ Sv/h. The annual effective dose of the population due to the outdoor gamma radiation was also calculated and it was varied from 0.438–8.585 mSv.

*Department of Physics, Mawlana Bhashani Science and Technology University

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

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

Objective: To measure real-time gamma radiation from natural and artificial radionuclides.

Current Progress: In-Situ Environmental gamma-ray dose rate was measured at 57 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 0.112-6.191 μ Sv/h (indoor) and 0.050-0.250 μ Sv/h (outdoor). The annual effective dose of the population due to the environmental gamma radiation was also calculated and it was varied from 0.174–10.150 mSv (indoor), 0.087-0.438 mSv (outdoor).

*Department of Physics, Jahangirnagar University

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

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

Objective: To measure real-time gamma radiation from natural and artificial radionuclides.

Current Progress: In-Situ Environmental gamma-ray dose rate was measured at 60 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 0.049-2.809 μ Sv/h (indoor) and 0.060-0.230 μ Sv/h (outdoor). The annual effective dose of the population due to the environmental gamma radiation was also calculated and it was varied from 0.076–4.386 mSv (indoor), 0.087-0.402mSv (outdoor).

*Department of Physics, Jahangirnagar University

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

M.S. Rahman, FabihaShafiMim*, S. Yeasmin, M.M.M. Siraz, S. Pervin, S. Hossain, N.Sultana,Z. Hossain and Shafi M. Tareq*

Objective: 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.

Current Progress: 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 0.114- 0.326, 0.11-0.25, 0.101-0.225, 0.109-0.162, 0.121-0.330 μ Sv/h.

*Department of Environmental Sciences, Jahangirnagar University

1.13 Radiation Monitoring at Indoor Places of Shahbag Thana using Thermoluminescent Dosimeters

M.S. Rahman, P. J. Orchy*, S. Yeasmin, M.M.M. Siraz, S. Pervin, S. Hossain, N. Sultana, Z. Hossain and J. Islam*

Objective: To measure the indoor radiation of Shahbag Thana from natural and artificial radionuclides.

Current Progress: Indoor radiation was measured at 20 locations of Shahbag Thana using thermoluminescent dosimeters. The measurement was performed from Nov 2022-April 2023. The indoor radiation dose rate varied from 302- 450 μ Sv/month with an average of 338 μ Sv/month. The annual effective dose of the population due to the indoor gamma radiation was also calculated and it was varied from 1.102–2.732 mSv.

*Department of Physics, Mawlana Bhashani Science and Technology University

1.14 Continuous Radiation Monitoring at Indoor Places of Lalbagh Thana Using Thermoluminescent Dosimeter

M.S. Rahman, M. S. Hossain*, S. Yeasmin, M.M.M. Siraz, S. Pervin, S. Hossain, N. Sultana, Z. Hossain and J. Islam

Objective: To measure the indoor radiation of Lalbagh Thana from natural and artificial radionuclides.

Current Progress: Indoor radiation was measured at 20 locations of Lalbagh Thana using thermoluminescent dosimeters. The measurement was performed from October 2022-March 2023. The indoor radiation dose rate varied from 295- 411 μ Sv/month with an average of 342 μ Sv/month. The annual effective dose of the population due to the indoor gamma radiation was also calculated and it was varied from 1.093–2.895 mSv.

*Department of Physics, Mawlana Bhashani Science and Technology University

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

M.S. Rahman, R. Akter*, S. Yeasmin, M.M.M. Siraz, S. Pervin, S. Hossain, N. Sultana, Z. Hossain and H. R. Khan*

Objective: 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.

Current Progress: In-Situ indoor radiation was measured at 32 locations of Khulna City 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 0.087- 0.41 μ Sv/h with an average of 0.171 μ Sv/h. The annual effective dose of the population due to the outdoor gamma radiation was also calculated and it was varied from 0.229–0.382 mSv.

*Physics Discipline, Khulna University

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

M.S. Rahman, A. Hossain*, S. Yeasmin, M.M.M. Siraz, S. Pervin, S. Hossain, N. Sultana, Z. Hossain and M. K. U. Sikder*

Objective: 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.

Current Progress: 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 0.040- 0.620 & 0.099-0.371 μ Sv/h respectively. The annual effective dose of the population due to the outdoor gamma radiation was also calculated and it was varied from 0.070–1.086 & 0.173-0.649 mSv respectively.

*Department of Physics, Jahangirnagar University

1.17 Study on Outdoor Radiation in AERE Campus by In-Situ Method

M.S. Rahman, M. N. Mahfuz*, S. Yeasmin, M.M.M. Siraz, S. Pervin, S. Hossain, N. Sultana, Z. Hossain and M. K. U. Sikder*

Objective: 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.

Current Progress: In-Situ indoor radiation was measured at 32 locations of AERE 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 0.119- 0.188 μ Sv/h with an average of 0.139 μ Sv/h. The annual effective dose of the population due to the outdoor gamma radiation was also calculated and it was varied from 0.209–0.466 mSv.

*Department of Physics, Jahangirnagar University

1.18 Synthesis and Thermoluminescence Properties of LiCaPO₄ Phosphor

A.K.M. Mizanur Rahman, Md. Raghib Rahat*, Homaira Afia Mimi*, Md. Kamruzzaman*, Z. Hossain, S. Hossain, S. Yeasmin

Objective: Many minerals and compounds show thermoluminescence (TL) properties but only few of them can meet the requirement of an ideal dosimeter. To investigate TL properties and kinetic parameters, the phosphor was irradiated with 6.0 MV (photon energy) and 6.0 MeV (electron energy) from a linear accelerator for doses ranging from 0.5 Gy to 6.0 Gy.

Current progress: An ABPO₄-type (A=Lithium, B=Calcium) phosphate phosphor is synthesized using modified solid-state diffusion method in this study. For both photon and electron energy, TL glow curves have two identical peaks near 200°C and 240°C. The dose against the TL intensity curve shows that the response is almost linear to the investigated dose range. For photon and electron energy, the phosphor is found to be the most sensitive at 2.0 Gy and 4.0 Gy, respectively. The phosphor has very low fading and after 28 days of end of Irradiation, it shows a signal loss of better than 3%. The studied TL properties suggest the suitability of LiCaPO₄ in radiation dosimetry and associated field.

*Department of Physics, Begum Rokeya University, Rangpur.

1.19 Thermoluminescence Properties of Synthesized ZnLiBO₃

A.K.M. Mizanur Rahman, Md. Raghib Rahat*, Homaira Afia Mimi, Md. Kamruzzaman*, Z. Hossain, S. Hossain, S. Yeasmin

Objective: For dosimetric purposes, the thermoluminescence characteristics of zinc lithium borate can be employed. Zn and Li in the compound ZnLiBO₃ stand for monovalent and divalent cations, respectively. The thermoluminescence capabilities of ZnLiBO₃ are among the best of all borate compounds.

Current progress: TL dose responses of ZLB were evaluated over the range of 0.5-8.0 Gy. The TL response is almost linear. The linear dose-response of the material shows that the number of traps generated due to irradiation is proportional to the dose of gamma radiation and can be explained by the track interaction model (TM). The model opined that the population of traps produced in a phosphor due to irradiation depends on the length of the track in the matrix as well as. A comparison linearity curve between 6 MV photon energy and 6MeV electron energy shows that ZnLiBO₃ follows the same trend. This work helped us to gather knowledge about TL properties for the synthesized sample ZLB. By studying the TL properties of ZLB, it can be used in both radiation and environment dosimetry.

* Department of Physics, Begum Rokeya University, Rangpur.

1.20 Thermoluminescence Properties of Lithium Zinc Borate (LiZnBO_3) and Effect of Rare Earth Materials as Dopant

A.K.M.Mizanur Rahman, Azharul Islam, Md. Kamruzzaman*, Z. Hossain, S. Hossain and S. Yeasmin

Objective: Cerium as a dopant in LZB is a pioneer work itself and analysis of the difference between the undoped LZB and Ce doped LZB comes with a quite satisfying result and a new way to understand the effect of doping in the mother compound.

Current progress: Sample preparation is a critical step in any experimental methodology, particularly in the field of thermal analysis. Thermal analysis techniques rely on precise measurements of the physical and chemical properties of a material as a function of temperature, which can be influenced by factors such as sample composition, particle size, and homogeneity. To obtain reliable and accurate data, it is essential to properly prepare the sample before analysis. Different materials' TL characteristics fluctuate according to their structural characteristics. The concepts and procedures for the synthesis and characterization of LiZnBO_3 : Ce and LiZnBO_3 are covered in this research.

* Department of Physics, Begum Rokeya University, Rangpur.

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

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

Objective: To measure the radioactivity and assess the radiological hazard associated with various environmental samples.

Current progress: To prepare baseline data of environmental background radiation around the Rooppur Nuclear Power Plant (RNPP) site, total 133 samples (soil and vegetation=23, water=49, sediment and aquatic vegetation= 32, and food stuffs=29) were collected from the 32 km radial distance of RNPP. Among these samples 65 samples were processed following the standard procedures as International Atomic Energy Agency (IAEA) guidelines. All samples were processed following the standard procedures as International Atomic Energy Agency (IAEA) guidelines. After preparation, samples are being counted by using high-purity germanium (HPGe) detector with relative efficiency of 30%. The work is in progress.

1.22 Determination of Radioactivity in Environmental Samples Collected (from 18-10-2021 to 28-10-2021) from the 32 km Radial Distances of Rooppur Nuclear Power Plant

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

Objective: To measure the radioactivity and assess the radiological hazard associated with various environmental samples.

Current progress: To prepare baseline data of environmental background radiation around the Rooppur Nuclear Power Plant (RNPP) site, total 96 environmental samples (Surface water 44, sand and sediment-11, rain water-08, aquatic vegetation-05, air particle-08, for radon measurement -20 surface water) were collected 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.

1.23 Background Radiation Survey in the 32 km Radial Distances of Rooppur Nuclear Power Plant

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

Objective: To measure the background gamma radiation in the 32 km radial distance of Rooppur Nuclear Power Plant.

Current progress: To prepare baseline data of environmental background radiation around the Rooppur Nuclear Power Plant (RNPP) site, background gamma radiation monitoring was performed in the 32 km radial distances of RNPP. The radiation survey work was conducted in 17-30 January, 2022. The equipment used for the measurement of radiation dose level is Radiation Survey Meter (Gamma-Scout). This is the third (winter 2nd time) survey on background gamma radiation dose level survey and its distribution around RNPP. The dose at the gonad level (1 m above the surface) varied from 0.06 to 0.12 $\mu\text{Sv/h}$.

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

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

Objective: To measure the radioactivity and assess the radiological hazard associated with various environmental samples.

Current progress: 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.

1.25 Background Radiation Survey in the 32 km Radial Distances of Rooppur Nuclear Power Plant in 1st Quarter of 2023

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

Objective: To measure the background gamma radiation in the 32 km radial distance of Rooppur Nuclear Power Plant.

Current progress: To prepare baseline data of environmental background radiation around the Rooppur Nuclear Power Plant (RNPP) site, background gamma radiation monitoring was performed in the 32 km radial distances of RNPP. The radiation survey work was conducted in 02-13 January, 2023. The equipment used for the measurement of radiation dose Level is Radiation Survey Meter (Gamma-Scout). This is the fourth (winter 3rd time) survey on background gamma radiation dose level survey and its distribution around RNPP. The dose at the gonad level (1 m above the surface) varied from 0.051 to 0.230 $\mu\text{Sv/h}$.

1.26 Determination of Radioactivity in Environmental Samples Collected from the 32 km Radial Distances of Rooppur Nuclear Power Plant in 1st Quarter of 2023

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

Objective: To measure the radioactivity and assess the radiological hazard associated with various environmental samples.

Current progress: 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 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.

1.27 Measurement of Radon in Drinking Water of Dhaka City using RAD7 and the Assessment of Resulting Dose to Local Population

Shikha Pervin, Md. Minhaz Kabir*, Sabrin Abdus Samad, Selina Yeasmin

Objective: To measure radon level in ground water in Dhaka city.

Current progress: Twenty samples of deep well waters of Dhaka WASA were collected to analyze the amount of Radon using RAD H20 detector. The activity of Radon in twenty samples of underground water ranged from 1330 Bqm-3 to 3940 Bqm-3 with a mean value of 2270 Bqm-3. Activity concentration in all the samples were below the recommended MCL of USEPA and WHO, which were 11,100 Bqm-3 and 10,000 Bqm-3 respectively. The values found in this study were compared with values found in same type of study in other countries and similarities were found among them. The ingestion dose, inhalation dose and total effective dose due to consumption of Radon were also calculated. Three age groups were considered during the calculation of the doses.

*Department of Nuclear Engineering, University of Dhaka

1.28 Study of Gross Alpha and Gross Beta in Drinking Water in Bogura District using ZnS Scintillation Detector and Associated Health Hazard Assessment

S. Pervin, M.R. Islam*, M.J. Dewan and S. Yeasmin

Objective: To evaluate gross alpha and gross beta levels in groundwater samples.

Current progress: Gross alpha and beta activities were determined for thirty drinkable water samples collected from different locations of Bogura district. ZnS detector was used to count the gross alpha and beta in collected samples. Average Concentrations of gross alpha 2.85 ± 0.29 mBq/L and gross beta 85.15 ± 1.75 mBq/L were observed which did not exceed WHO recommended levels and were comparable with the ICRP (2007) recommendation of 100 μ Sv/year. The annual effective dose equivalent for adults, children and infants varies from (6.16 to 86.65) μ Sv/y, (3.08 to 43.32) μ Sv/y and (1.53 to 21.65) μ Sv/y respectively. And the average total annual effective dose equivalent values for adults, children and infants are 43.47 μ Sv/y, 21.73 μ Sv/y and 10.86 μ Sv/y respectively. The lifetime cancer risk probability increases in comparison to background by only 0.023% in average.

*Department of Nuclear Engineering, University of Dhaka

1.29 Measurement of Gross Alpha and Gross Beta in Drinking Water from Tangail District using Zinc Sulphide Scintillation Detector (ZnS)

S. Pervin, S. Afsana*, M.M. Haider and S. Yeasmin

Objective: To assess the radiation hazards with the activity of alpha/beta radiation associated with the consumption of water by people.

Current progress: Water is an indispensable element for every human, animal and plants in earth. So, the aim of this study was to determine the gross alpha and gross beta activity in ground water. Fifteen ground water samples were collected from different places under Tangail District in Bangladesh. The samples of water were collected from tube-well. The study was performed by using Zinc Sulphide Scintillation detector. The gross alpha activity concentration was ranged from 0.0009 ± 0.0017 Bq/L to 0.0126 ± 0.0003 Bq/L with an average value of 0.0048 ± 0.00208 Bq/L. The gross beta activity concentration was ranged from 0.0344 ± 0.0337 Bq/L to 0.2325 ± 0.0290 Bq/L with an average value of 0.0857 ± 0.0246 Bq/L. All the values of activity concentration for gross alpha and beta of ground water samples were well below the standard value of gross alpha and beta activity.

*Department of Physics, Mawlana Bhashani Science and Technology University

1.30 Measurement of Outdoor Environmental Gamma Radiation Dose Rate Using Gamma Scout around Some Pharmaceutical Companies at Tongi Under Gazipur.

S. Pervin, N. Sarker*, M.M. Haider and S. Yeasmin

Objective: To measure environmental background radiation

Current progress: Outdoor environmental gamma radiation dose rates were measured around some pharmaceutical companies at Tongi in Gazipur from February to March 2023. For this purpose, a digital portable Gamma-Scout detector was used and from nine selected monitoring points gamma dose rates were measured. The measurements were performed during light day. Global Positioning System (GPS) navigation was used to mark out monitoring points. The GPS reading of sampling locations varied from E: $90^{\circ}23.294'$ to E: $90^{\circ}24.811'$ and from N: $23^{\circ}53.571'$ to N: $23^{\circ}54.288'$. The measured outdoor gamma radiation dose rates were ranged from 0.112 ± 0.002646 μ Svh⁻¹ to 0.35 ± 0.001 μ Svh⁻¹ with an average of 0.21198 ± 0.00949 μ Svh⁻¹. Annual effective dose due to outdoor environmental gamma radiation to the population was varied from 0.137357 ± 0.003245 mSv to 0.42924 ± 0.0012264 mSv with an average of 0.25998 ± 0.01165 mSv. This result shows that there is no burden of population exposure due to man-made sources and radiation protection of radiological facilities had ensured, that is necessary for minimizing of unnecessary exposure to populations from man-made sources.

*Department of Physics, Mawlana Bhashani Science and Technology University

1.31 Occupational Radiation Exposure among the Workers in Major Medical Practices

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

Objective: 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.

Current progress: The occupational radiation exposures for 3597 workers were investigated in the fields of radiotherapy (RT), cardiology (CD), nuclear medicine (NM) and industrial radiography throughout Bangladesh in 2022 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 ($H_p(10)$).

1.32 Measurement of Gross Alpha and Gross Beta in Water from various Pharmaceutical Companies of Bangladesh.

N. Sultana, S. Pervin, M.M.M. Siraz, M. F. Kabir, S. Banik, N Hassan, and S. Yeasmin

Objective: The aim of this study is to measure the activity of gross alpha and gross beta in water used in various pharmaceutical companies of Bangladesh.

Current progress: Twenty 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 eleven samples were measured by the detector. Among the measured sample minimum detected alpha activity is 0.002 Bq/L, beta activity is 0.04 Bq/L and maximum alpha activity is 0.009 Bq/L, beta activity is 0.14 Bq/L. Further work is in progress.

1.33 Environmental Radiation Surveillance by Using Thermoluminescent Dosimeter around AECD Campus.

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

Objective: The object of this study is to measure background radiation because human beings are always exposed to environmental radiation.

Current progress: The measurements were performed at different locations in the AECD campus, using TLD-100 (LiF: Mg, Ti) chip dosimeters were placed in the radiation monitoring post. There are 10 (ten) customized radiation monitoring posts each containing 5 (five chips) was placed 1m above the ground level (gonad height) in light-tight condition. The chips were collected to compare the seasonal variation by Thermo Scientific™ HARSHAW TLD™ Model 3500 Manual Reader. The result of the background measurements was also compared with the data of the digital beta/gamma survey meter. From this study, the result showed average background radiation in this area is ~ 1.23 mSv/y. The absorbed dose of TLD-100 remained in good agreement (typically within $\pm 5\%$ but in some cases extending beyond this) with the results from survey meter data.

1.34 Measurement of Artificial Radionuclides in Imported and Exportable Foodstuffs Samples of Bangladesh using of Gamma Spectrometry System

N. Hassan, N. Sultana, S. Pervin and S. Yeasmin

Objective: To monitor the level of radioactivity in different food samples imported from SAARC and other countries as a part of radioactivity monitoring surveillance program.

Current progress: In the year of July 2020-June 2021 total 2689 different kind of imported and exportable foodstuffs (Milk & Milk product, personal and other) samples, were examine to detect ^{137}Cs nuclides using a high purity germanium detector with 30% efficiency. The efficiency and energy calibration of the HPGe detector was conducted using standard source. Each sample was prepared according to IAEA Technical Report Series-295. It was found that the activity concentration of ^{137}Cs was below than the limit recommended by Nuclear Safety and Radiation Control (NSRC) rules-1997 and Bangladesh Atomic Energy Regulatory (BAER) Act-2012. Therefore, each of the samples was found to be free from ^{137}Cs concentration.

2. Manpower Development

Sl. No.	Title	Date	Place	No. of participant
01	Seminar on Occupational Exposure control- using TLD	28 May, 2023	Auditorium, Atomic Energy Centre, Dhaka	38
02	Seminar on Environmental Radioactivity Monitoring	06 June, 2023	Auditorium, Atomic Energy Centre, Dhaka	16

3. Seminar/Symposium/Conference/Workshop Attended

Name of the person	Title of the event	Organizer	Date	Place
S.Yeasmin	Regional Workshop on Radiological Environmental Impact Assessment for Nuclear Installations	IAEA	24-28 October 2022	Manila, Philippine
	International Conference on BCSIR CONGRESS-2022,	BCSIR	1-3 December 2022	BCSIR
	Regional Workshop on the Implementation of Management System by Technical Services Providers.	IAEA	05-09 December 2022	Dhaka, Bangladesh
	TC Regional Workshop on Strategies for Proper Implementation of General Safety Requirements (GSR Part 3) Requirements for Occupational Exposure.	IAEA	18-22 December 2022	Amman, Jordan
	International Conference on Electronics and Informatics -2022.	Bangladesh Electronics and Informatics Society	26-28 January 2023	AECD
	1 st International Dhaka Science conference for Women, WSTC-2023.	Nanomaterials Group, Dhaka and International Science Programme of Uppsala University, Sweden	15-16 February 2023	Hotel Pan Pacific Sonargaon, Dhaka
	National Conference on Physics-2023	BPS	09-11 March 2023	Zoom Platform
Dr. M.S. Rahman	Second International Conference on Applications of Radiation Science and Technology	IAEA	22-26 August 2022	IAEA HQ, Vienna, Austria
	International Conference on Occupational Radiation Protection: Strengthening Radiation Protection of Workers-Twenty Years of Progress and the Way Forward.	IAEA	01-05 September 2022	IAEA HQ, Vienna, Austria
	BCSIR Congress-2022.	BCSIR	1-3 December 2022	BCSIR
	6 th Asian and Oceanic Congress on Radiation Protection.	IRPA, IARP	07-11 February 2023	AECD
	International Conference on Electronics and Informatics	BES	26-28 January 2023	AECD
	National Conference on Physics-2023.	BPS	09-11 March 2023	Zoom Platform

Name of the person	Title of the event	Organizer	Date	Place
Dr. A. K. M.M.Rahman	Regional Workshop on the Implementation of Management System by Technical Services Providers.	IAEA	05-09 December 2022	Dhaka, Bangladesh
	RTC on Roles Responsibility, Education & Training of Medical Physicist and Certification for Clinically Qualified Medical Physicist.	IAEA	27 to 31 March 2023	Krabi, Thailand
	Regional Workshop on External Dosimetry with particular focus on Extremity and Monitoring of the Eye Lenses.	IAEA	7 to 11 May 2023	Doha, Qatar
M.M.M. Siraz	International Workshop on Termination of a Nuclear or Radiological Emergency.	IAEA	12-15 July 2022	Vienna, Austria
	International Conference on Electronics and Informatics -2022.	Bangladesh Electronics and Informatics Society	26-28 January 2023	AECD
	National Conference on Physics-2023.	BPS	09-11 March 2023	Zoom Platform
S. Pervin	Regional Workshop on the Implementation of Management System by Technical Services Providers.	IAEA	05-09 December 2022	Dhaka, Bangladesh
	International Conference on Physics 2022.	Bangladesh Physical Society	19-21 May, 2022	Atomic Energy Centre, Dhaka
	International Conference on Physics in Medicine.	Bangladesh Medical Physics Association	26-27 May, 2022	Atomic Energy Centre, Dhaka
	1 st International Dhaka Science conference for Women, WSTC-2023	Nanomaterials Group, Dhaka and International Science Programme of Uppsala University, Sweden	15-16 February, 2023	Hotel Pan Pacific Sonargaon, Dhaka
N. Hassan	Follow -up Training Course on “Environmental Radioactivity Monitoring Course at BAEC-2023”.	Bangladesh Atomic Energy Commission (BAEC) & Japan Atomic Energy Agency (JAEA)	15-19 January, 2023	Training Institute, AERE, Savar, Dhaka
	International Conference on Electronics and Informatics 2023	Bangladesh Electronics and Informatics Society (BEIS)	26-28 January, 2023	AECD
	International Conference on BCSIR CONGRESS-2022,	Bangladesh Council of Science and Industrial Research (BCSIR)	1-3 December, 2022	BCSIR
Dr. S. Hossain	Seminar on “Boron Nanostructure on Refractory Metal Surfaces”	AECC	19 October 2022	AECC
	Theoretical and Practical FRN Methods Focusing on Cs-137 and Pb-210 for Erosion Assessment and Field Work for Designing the FRN Study.	BAEC and IAEA	13 – 26 February 2023	BAEC Headquarter
	ACS Spring meeting 2023	American Chemical society (ACS)	26 – 30 March 2023	Virtual (Zoom)
	Seminar on “Occupational Exposure Control using TLD”.	AECD	28 May 2023	AECD

Name of the person	Title of the event	Organizer	Date	Place
	Seminar on “Environmental Radiation Monitoring”.	AECD	06 June 2023	AECD
N. Sultana	Bangladesh National Training Course on Nuclear Material Accounting and Control for Nuclear Security Purposes at Facilities.	IAEA	15 to 17 November 2022	St. Petersburg, Russian Federation
	Occupational Radiation Protection Based on General Safety Guide No. GSG-7.	IAEA	05 December 2022	Online
	Regional Workshop on the Implementation of Management System by Technical Services Providers.	IAEA	05-09 December 2022	Dhaka, Bangladesh
	International Conference on Electronics and Informatics -2022.	Bangladesh Electronics and Informatics Society	26-28 January 2023	AECD
	1 st International Dhaka Science conference for Women, WSTC-2023	Nanomaterials Group, Dhaka and International Science Programme of Uppsala University, Sweden	15-16 February, 2023	Hotel Pan Pacific Sonargaon, Dhaka

4. Collaboration Work

To implement radiation protection program, HPD has been working in collaboration with International Atomic Energy Agency (IAEA) as well as government of Bangladesh in different projects;

Collaboration Project with MOST, GOB and MOE, GOB & IAEA:

- RAS/9093 -Strengthening Technical Services in Occupational Radiation Protection in Compliance with the International Basic Safety Standards
- Special Research Allocation Project: 2022-2023 under MOST, GOB
- Grant of Advanced Research in Education: 2020-2021, 2021-2022, 2022-2023 under MOE, 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

5.1 Services Rendered to Imported and Exportable Food Samples

During the reporting period, 1630 imported milk & milk products samples & other samples and exportable samples were tested in this division.

List of number of the sample per month for radioactivity testing of imported and exportable food items from this division during the reporting period (July 2022-June 2023)

Name of the month	Milk & milk products (A)	Others (B)	Imported C = A+B	Domestic product	Auctions	Individual product	Monthly total
July, 2022	63	162	225			2	227
August, 2022	36	115	151			0	151
September, 2022	88	149	237			1	238
October, 2022	57	101	158			3	161
November, 2022	54	175	229			1	230
December, 2022	43	98	141			0	141

Name of the month	Milk & milk products (A)	Others (B)	Imported C = A+B	Domestic product	Auctions	Individual product	Monthly total
January, 2023	32	54	86			3	89
February, 2023	16	51	67			1	68
March, 2023	31	58	89			0	89
April, 2023	22	37	59			0	59
May, 2023	43	68	111			2	113
June, 2023	15	47	62			2	64
Grand Total =1630							

5.2 Gross Alpha and Gross Beta Service Provided

List of gross alpha service provided during July 2022-June 2023

	Type of sample	No. of sample	Total parameters
Health care life Science Ltd.	Supply Water	6	3
Aristropharma Ltd., Dhaka	Bore Hole Water	1	1
UL VS Bangladesh Ltd. Dhaka	Waste Water	4	4
Total =		11	8

5.3 Service Provided to New Organizations

Number of new TLD badges issued to different new organizations during the period July 2022-June 2023

Name of the month	No. of new organizations	No. of new workers
July, 2022	28	83
August, 2022	52	88
September, 2022	63	97
October, 2022	90	108
November, 2022	37	82
December, 2022	27	54
January, 2023	31	68
February, 2023	24	48
March, 2023	23	68
April, 2023	19	54
May, 2023	33	47
June, 2023	15	26
Total	442	823

5.4 Service of Dose Measurement and Reporting

Evaluated number of TLD badges with number of organization from July 2022-June 2023

Name of the month	Number of organizations	Number of measured TLD badges
July, 2022	318	1014
August, 2022	364	1035
September, 2022	444	1195
October, 2022	380	1334

Name of the month	Number of organizations	Number of measured TLD badges
November, 2022	390	1348
December, 2022	443	1119
January, 2023	569	1427
February, 2023	170	566
March, 2023	506	1436
April, 2023	403	1273
May, 2023	483	1645
June, 2023	160	529
Total	4630	13921

5.5 Individual Monitoring Service

List of individual radiation monitoring service provided to the occupational workers of different radiation practices from July 2022-June 2023.

Practices	Number of organizations	Number of radiation workers
Radiotherapy	17	544
Nuclear Medicine	18	507
Industrial Radiography	59	394
Diagnostic Radiology	5374	9567
Research	23	409
Others (Quality Control, Level Gauge etc)	149	706
Total	5640	12131

Materials Science Division, AECD

Objective

Materials Science Division, AECD, has been pursuing research on advanced materials of nanotechnology, biotechnology, and information technology and conducted research on different advanced materials for electronic, magnetic, biomedical, water treatment, nano fertilizer, nuclear, and thermoluminescence dosimetry applications. There was success in removing heavy elements like chromium, lead, cadmium, and arsenic from wastewater, obtaining a similar yield of Boro rice with a 50% reduction of urea by transforming it to nano urea. Achieved the development of a contrast agent for magnetic resonance angiography/imaging through polysaccharide/ferrite nanohybrid, developed various phosphors, functionalized carbon nanotubes, reduced graphene oxides and composites with ceramic oxides for electronic and biomedical applications.

Program

Research and development works of this division are as follows:

- Development of spinel type soft nano and bulk ferrites using magnetite and commercial grade raw materials and study of their characteristic properties
- Synthesise, characterization and study for dielectric, ferroelectric and nanometric scale ferrite /piezoelectric applications for their applications as MRI contrast agent and hyperthermia mediating agent.
- Development of ferrite permanent magnets from magnetite extracted from Cox's Bazar beach sand
- Study of the magnetic and structural properties of amorphous/ nanocrystalline materials
- Study of the structural and magnetic properties of perovskites for magnetocaloric and magneto resistive applications
- Crystallographic characterization and quantitative phase study of inorganic, organic, thin film and unknown materials by XRD method

- Study of the magnetic and electrical properties of microwave ferrite materials
- Mineralogical study of soil, rock, clay, terracotta and silt materials by XRD method
- Synthesis and Characterization of Polymer/Ceramic and Polymer/hydroxyapatite nanohybrid for bone and tooth implant, materials for biomedical Application
- Synthesis and Characterization of Carbonaceous materials such as Carbon nanotube, reduced graphene Oxide and their nano hybrids and/or nanocomposites Graphene Oxide and Reduced and its application as biomedical coating

Activities

1. Research and Development

1.1 Lignin Nanoparticles as pH-Responsive Nanocarriers for Hydrophobic Oral Drugs

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, T. I. Aquib *

Objective: The objective of the work is to Lignin Nanoparticles as pH-responsive Nanocarriers for Hydrophobic Oral Drugs

Current progress : This present work reports on the preparation of lignin nanoparticles (LMPs) from alkali lignin (AL) in order to examine their applicability as nanocarriers for external stimuli responsive delivery of hydrophobic oral drugs. Aspirin was chosen as model hydrophobic oral drug. The LNPs were developed by acid precipitation method which involved precipitation of lignin from a high pH aqueous alkaline pH aqueous acidic solution. The average particle size, size distribution of low pH aqueous acidic solution. The average particle size, size distribution and surface morphology of the LNPs were characterized via dynamic light scattering (DLS) method and transmission electron microscopy (TEM). The LNPs were uniformly shaped, highly dispersed and spherical with an average particle size of 201.37 ± 1.20 nm polydispersity index (PDI) value of 0.284 ± 0.012 . The chemical structure of the LPNs was analyzed by Fourier transform infrared spectroscopy (FT-IR). LNPs exhibited absorption bands typical for alkali lignin which confirmed that the basic lignin structure did not change during nano partical preparation. Next, aspirin was loaded into the nanoparticles and they exhibited satisfactory drug loading capacity (%DL) of $39.12 \pm 50\%$ and excellent encapsulation efficiency (EE) of $91.44 \pm 0.59\%$.

* Department of Applied Chemistry and chemical Engineering, Chittagong University, Chittagong

1.2 Facile Synthesis of $\text{Bi}_{0.85}\text{La}_{0.15}\text{FeO}_3$ to Study Multiferroic Properties with the Heat 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, I. J. Isha *

Objective: The objective of the work is to facile synthesis of $\text{Bi}_{0.85}\text{La}_{0.15}\text{FeO}_3$ to study multiferroic properties with the heat treatment

Current progress: Bismuth ferrite has gained considerable attention recently as a viable multiferroic material because of their potential applications in information storage, sensors, photocatalysts, spintronic devices and photovoltaic cells. Multiferroic composites Lanthanum substituted Bismuth ferrites $\text{Bi}_{0.85}\text{La}_{0.15}\text{FeO}_3$ was synthesized by using chemical co-precipitation method at various sintering temperatures (800°C and 850°C) and were investigated by XRD, FTIR, TEM, PPMS and P-E loop for structural, magnetic and ferroelectric properties. Phase analysis, lattice constant, bulk density and grain size were studied by XRD. The average crystallite size is 21.33 nm at 850°C . The TEM image shows the crystal size and shape, as well as the particle size distribution. By analyzing the results from different measurements it was determined that crystal structure of La substituted BFO is rhombohedral distorted perovskite structure with $R3c$ symmetry and products have nanocrystal sized. By using M-H curve up-to 5T at 5K to 300K and M-T curve at small and high field, Magnetic properties such as saturation magnetization, coercivity, and remanence were calculated. The magnetic nanoparticle shows their potential for the application of soft magnetic materials. The P-E loops of the composite illustrate an unsaturated and broken rectangular loop. Maximum Polarization is found about $0.4640 \mu\text{C}/\text{cm}^{-2}$ at 850°C .

* Department of Physics, University of Chittagong, Chittagong

1.3 Multiferroicity of Samarium Substituted Multiferroic Bismuth Ferrite

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, I. A. Mitu *

Objective: The objective of the work is multiferroicity of samarium substituted multiferroic bismuth ferrite

Current progress: BiFeO₃ is one of the important materials which possesses numerous applications in material science and belongs to the multiferroic family of single-phase magneto-electric materials. Synthesized by Co-precipitation method with the composition of Bi_{0.85}Sm_{0.15}FeO₃ ferrite at various calcination temperatures (800°C and 850°C). Phase analysis and investigation of structural, magnetic and ferroelectric properties have been done by using X-ray Diffractometer, Transmission Electron Microscopy (TEM), Fourier Transform Infrared Spectroscopy (FTIR), M-H hysteresis loops and P-E loop. The crystal structure of pure BFO is rhombohedrally distorted perovskite structure with R3c symmetry. The maximum value of crystallite size is found about 17.89 nm at 800°C and maximum bulk density is found 4.680 gm/cm³. FTIR spectra of the samples were measured within the range 350–1500 cm⁻¹ and pure phase of the composition has been confirmed from the XRD results. M-H hysteresis loops show a significant change in remnant magnetization, saturated magnetization and coercive field, with various sintering temperatures. Saturation magnetization is found 0.720 emu/gm at 850°C. The P-E loops of the composite for various sintering temperatures illustrate an almost rectangular loop. Maximum Polarization is found about 0.857 μC/cm² at 850°C.

* Department of Physics, University of Chittagong, Chittagong

1.4 Synthesis & Characterization of A₂BO₅ and A₂B₂O₇ (A=Sm; B=Sn, Ti) Compounds & Their Structural Analysis under Gamma Irradiation

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

Objective: The objective of the work is to synthesis & characterization of A₂BO₅ and A₂B₂O₇ (A=Sm; B=Sn, Ti) compounds & their structural analysis under gamma irradiation

Current progress: The present work is concerned with the synthesis of four novel ceramic compounds A₂BO₅ and A₂B₂O₇ (A=Sm³⁺ and B=Sn⁴⁺, Ti⁴⁺). All the four samples were sintered at 1200°C and 1400°C for 12 hours by solid state reaction route. Three characterization techniques namely X-Ray Diffraction (XRD), Fourier Transform Infrared (FT-IR) spectroscopy and Transmission electron Microscopy (TEM) were conducted to identify the expected crystal phase, chemical bond or functional group, crystallinity and granular orientation. Then all the samples were irradiated under Co-60 gamma source (Activity ~59KCi) at various absorption doses i.e. 800Gy, 3200Gy and 20000Gy to discern the crystallographic behavior under this extreme environmental condition. The radiation induced amorphization resistance capabilities among the candidates were compared from the parameters such as lattice parameters such as lattice parameter, unit cell volume change, percentage crystallinity, crystallite size dislocation density microstructural strain. Whether the pyrochlore structure (Sm₂Sn₂O₇ and Sm₂Ti₂O₇) transformed into disordered fluorite was also investigated via XRD peak analysis. In addition, lattice deterministic code Dragon5 was run for the estimation of thermal neutrons conventional Dy₂TiO₅ absorber used in VVER-1000 reactor.

* Department of Nuclear Engineering university of Dhaka, Dhaka

1.5 Development of Yttrium-Tin and Yttrium-Titanium Based Fluorite and Pyrochlore Materials for Advanced Nuclear Applications

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. J. Ali *

Objective: The objective of the work is development of Yttrium-Tin and Yttrium-Titanium based fluorite and pyrochlore materials for advanced nuclear applications

Current progress: We developed four different compositions of A₂BO₅ and A₂B₂O₇ (A=Y; B=Sn, Ti) with the aim to study the influence of the size of A cations on amorphization of the composites after irradiation. The composites were synthesized using solid state reaction process. The present work is concerned with the synthesis of four novel ceramic compounds A₂BO₅ and A₂BO₇ (A=Y³⁺ and B=Sn⁴⁺, Ti⁴⁺). All the four samples were sintered at 1200°C and 1400°C for 12 hours. Three characterization techniques namely XRD, FTIR, spectroscopy and TEM were conducted to identify the expected crystal phase, chemical bond or functional group, crystallinity and granular orientation. Then all the samples were irradiated under Co-60 gamma source (Activity ~59KCi) at various absorption doses i.e. 800 GY, 3200 GY, 12800GY and 20000GY

to discern the crystallographic behavior under this extreme environmental condition. These prepared samples were then irradiated to simulate gamma-decay damage and were observed by electron microscopy. The XRD revealed that the sample exhibits better stability under swift heavy ion irradiation, implying that the sample possesses better radiation stability. The radiation-induced amorphization resistance capacities among the candidates were compared. Whether the pyrochlore structure ($\text{Y}_2\text{Sn}_2\text{O}_7$ and $\text{Y}_2\text{Ti}_2\text{O}_7$) transformed into disordered fluorite was also investigated via XRD peak analysis.

* Department of Nuclear Engineering, University of Dhaka, Dhaka

1.6 Development of Lanthanum-Tin & Lanthanum -Titanium Based Fluorite and Pyrochlore Materials for Advanced Nuclear Applications

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, Al-Amin *

Objective: The objective of the work is development of Lanthanum-Tin & Lanthanum Titanium based fluorite and pyrochlore materials for advanced nuclear applications

Current progress: The present work is concerned with the synthesis of four novel ceramic compounds A_2BO_5 and A_2BO_7 ($\text{A}=\text{La}^{3+}$ and $\text{B}=\text{Sn}^{4+}$, Ti^{4+}). All the four samples were sintered at 1200°C and 1400°C for 12 hours. Three characterization techniques namely X-Ray Diffraction (XRD), Fourier Transform Infrared (FT-IR) spectroscopy and Transmission electron Microscopy (TEM) were conducted to identify the expected crystal phase, chemical bond or functional group, crystallinity and granular orientation. Then all the samples were irradiated under Co-60 gamma source (Activity~59KCi) at various absorption doses i.e. 800Gy, 3200Gy, 12800Gy and 20000Gy to discern the crystallographic behavior under this extreme environmental condition. The radiation induced amorphization resistance capacities among the candidates were compared. Whether the pyrochlore structure ($\text{La}_2\text{Sn}_2\text{O}_7$ and $\text{La}_2\text{Ti}_2\text{O}_7$) transformed into disordered fluorite was also investigated via XRD peak analysis. Except that the reason behind the XRD peak shift and granular orientation are discussed in this work.

Department of Nuclear Engineering university of Dhaka, Dhaka

1.7 Synthesis and Characterization of $\delta\text{-MnO}_2$ Nano-flowers WO_3 Composites for Energy Storage & Magnetic Applications

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

Objective: The objective of the work is to synthesis and characterization of $\delta\text{-MnO}_2$ Nano-flowers WO_3 composites for energy storage & magnetic applications

Current progress: In this study, a novel, $\delta\text{-MnO}_2$ Nano-flowers/ WO_3 Nano-belts composite has been fabricated via a hydrothermal method by taking different concentrations of WO_3 (3, 5 and 7%). The FE-SEM images represent a three-dimensional flower-like structure for $\delta\text{-MnO}_2$ and $\delta\text{-MnO}_2$ Nano-flower/ WO_3 composites. The different structural parameters of the Nano-flowers were estimated from the XRD analysis. TEM analysis revealed that the inter-planar spacing of the nanostructure varied with the concentration of WO_3 Nano-belts. The specific capacitance as high as 215 F g^{-1} at 0.35 A g^{-1} together with high energy density were obtained for the $\delta\text{-MnO}_2$ Nano-flowers/ WO_3 Nano-belts (5%) nanocomposite from the electrochemical analysis. This improved specific capacitance of $\delta\text{-MnO}_2$ Nano-flowers/ WO_3 Nano-belts can be attributed to the higher surface area, defect-rich structure, and lower charge transfer resistance of the prepared sample. The $\delta\text{-MnO}_2$ Nano-flowers/ WO_3 Nano-belts nanostructure with improved specific capacitance and higher stability synthesized from a simple, low cost process will pave the way to the production of efficient and economic energy storage devices. Also the magnetic characterization was performed for the synthesized materials to investigate the magnetic properties of Metal-Oxides like $\delta\text{-MnO}_2$ and WO_3 . Superparamagnetism is found in the base materials and in the composites as well.

* Department of Materials and Metallurgical Engineering, BUET, Dhaka

1.8 Effect of Entropy Increase on Optical and Magnetic Behaviors of Doped Copper Oxide Nanoparticles

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

Objective: The objective of the work is effect of entropy increase on optical and magnetic behaviors of doped copper oxide nanoparticles

Current progress: Pure and doped copper oxide nanoparticles were synthesized by modified sol-gel process. Modified sol-gel process is a suitable process for the production of transition metal oxide nanoparticles. Copper oxide nanoparticles were doped with chromium (III) oxide, iron(III) oxide, cobalt oxide, nickel oxide and zinc oxide which increase the entropy of system with the increase of doping level. The nanoparticles were characterized using XRD and after the analysis, it was found that the crystal structure of the nanoparticles is monoclinic. Irregular shaped particles and the gradual reduction of crystallite size with doping was observed from TEM image analysis. The reduction of crystallite size with doping was observed from TEM image analysis. The reduction of optical band gap with the increase of doping level were observed from the analysis of the DRS spectra obtained from UV-VIS spectroscopy. From the analysis of the M-H curve plotted from the data obtained by testing the sample in PPMS, it was found that the saturation magnetization and remanent magnetization initially increase, reach a maximum, and then decrease and the coercivity of the nanoparticles increases with the increase if the system's entropy level.

* Department of Materials and Metallurgical Engineering, BUET, Dhaka

1.9 A comparative Study For Synthesizing Graphene Oxide (GO): A Study On Facile and Simplified Approach

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. Mim *

Objective: The objective of the work is comparative study for synthesizing graphene oxide (GO): a study on facile and simplified approach

Current progress: Hummer's method was used to produce Graphene Oxide with different degrees of oxidation and the reaction parameter in terms of water amount, and reaction time were varied to compare reaction rate. Among four batches of samples Batch-I and Batch-II had equal amount of oxidizing agent, water, reaction terminating agent. However, Batch-II was washed with acetone for further purification and mixed with acetone in a homogenizer. It was then dried and used in the synthesis process. However, the XRD and UV-VIS result revealed that Batch-I was more oxidized than Batch-II and IV the solid oxidizing agent used were same however Sulfuric acid used in Batch-III was 1.73 times more than Batch-IV. The color of the GO appeared to be lighter compared to other two batches. This work demonstrated a facile process to synthesis GO at a cheap cost and high efficiency, despite the fact that the pH of the sample was below neutral. X-ray diffraction, Fourier Transform Infrared spectra and UV-VIS spectroscopy were used to investigate the development of various oxygen-containing functional groups. FTIR spectra revealed that all four samples include hydroxy (-OH), epoxy (C-O) and carboxylic acid (-COOH).

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

1.10 Investigating Anti-bacterial and Anti-neoplastic Properties of Bio-Fabricated Nanoparticles Using Yeast

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

Objective: The objective of the work is investigating anti-bacterial and anti-neoplastic properties of Bio-fabricated Nanoparticles using yeast

Current progress: The biosynthesis of Silver Nanoparticles (Ag NPs) using a local yeast isolate and their potential antibacterial and anticancer effects are investigated in this work. Various characterization techniques such as UV-VIS, FTIR, XRD and TEM were used to confirm the size (approx. 38 nm), shape (spherical), crystalline nature, and organic origin of the synthesized Ag NPs. Zeta potential and hydrodynamic sizes were calculated using a particle size analyzer, indicating that the Ag NPs are well dispersed in suspension, making

them suitable for intravenous injection for therapeutic purposes. The results showed that the biosynthesized Ag NPs were effective in inhibiting the growth of all these microbes at a concentration of 450 µg/mL and could effectively kill them at a concentration of 1800 µg/mL, as evidenced by minimal inhibiting the growth of all these microbes at a concentration of 450 µg/mL and cold effectively concentration (MIC) and minimal bactericidal concentration assays. The anticancer activity of the yeast-mediated synthesized Ag NPs was evaluated against the HeLa cell line (in vitro) and Ehrlich as cites carcinoma cells (in vivo) and compared with the commercial antineoplastic drug bleomycin. The results revealed that the Ag NPs synthesized using yeast showed superior effectiveness in inhibiting the growth of cancer cells compared to bleomycin, both in vitro and in vivo.

* Dept. of Microbiology, Faculty of Biological Science, University of Dhaka, Dhaka

1.11 Biomaterial Coated Phage Therapy: An Approach to Treat Burn Wound Infections Caused by the Superbug *Pseudomonasaerugiosa*

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

Objective: The objective of the work is biomaterial coated phage therapy: an approach to treat burn wound infections caused by the superbug *Pseudomonas aerugiosa*

Current progress: The development of phage therapy to treat burn wound infections caused by *Pseudomonasaerugiosa*, a bacterium that is becoming increasingly resistant to antibiotic. It is obtained an Extreme Drug Resistant isolate of *P. aeruginosa* from a burn patient in Dhaka Medical hospital and screened it for 16 antibiotics, finding that it was resistant to all except colistin. A potential phage was purified from sewage samples and characterized through various test, including plaque size measurement, phage titer determination, one-step growth curve establishment, stress tolerance activity checking, bacterial growth reduction assay, biofilm reduction assay, and whole genome sequencing. To protect and extend the activity of the phages, they were coated with two different biomaterials-chitosan and alginate and their encapsulation efficiency as well as both in vitro and In vivo activity was observed. The study found that the purified phages were able to tolerate a wide range of temperatures (up to 65°C) and pH and had a latent period of 20 minutes and a burst size of 125 virions per cell. Microbeads and milibeads were formed during the encapsulation of phage with chitosan and alginate, respectively and both released phage in weak acetic acid solution (Chitosan Beads) and PBS buffer (Alginate Beads). In peritoneal and burn wound infection models, both coated and naked phages significantly reduced the bacterial count (p-value<0.05), with coated phages appeared to be more effective.

* Department of Materials and Metallurgical Engineering , BUET, Dhaka

1.12 Polybenzoxazine/Co_xMg_{1-x}Fe₂O₄ Nano Ferrite Composites: Synthesis, Identification and Optical Properties

S.M. Hoque, H. N. Das, R. Rashid, M. R. Hasan, A. Parveen, A. A. Begum, K. H. Fakir, A. Hossain, Z. Begum, N. Begum. A. Ghosh

Objective: The objective of the work is polybenzoxazine/Co_xMg_{1-x}Fe₂O₄ Nano Ferrite composites: synthesis, identification and optical properties

Current progress: In the present work, nano-ferrites of chemical composition: Co_xMg_{1-x}Fe₂O₄ 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 polymer. Specified weights of ferrites have been mixed with the monomer followed by thermal treatment to obtain the composites. 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 ZRD patterns and its 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 (6.5nm). 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.

Department of Materials and Metallurgical Engineering, BUET, Dhaka

1.13 Effect of Ti^{4+} Doping on Structural, Electrical and Magnetic Properties of $Ni_{0.4}Cu_{0.2}Zn_{0.4}Fe_{2-x}Ti_xO_4$ Ferrites

F. M. Kamal, 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, N. Begum, Z. Begum,

Objective: The objective of the work is to effect of Ti^{4+} doping on structural, electrical and magnetic properties of $Ni_{0.4}Cu_{0.2}Zn_{0.4}Fe_{2-x}Ti_xO_4$ Ferrites

Current progress: Ni-Cu-Zn ferrites with $Ni_{0.4}Cu_{0.2}Zn_{0.4}Fe_{2-x}Ti_xO_4$ ($x=0.00, 0.02, 0.05, 0.07, 0.10$)

Chemical compositions are prepared using conventional solid state reaction method. Therefore, Ti is substitutions are prepared using conventional solid state reaction method. In this study Ti is substituted for Fe at the B-site of the lattice. The structural property is studied by X-ray diffraction method. The X-ray diffraction patterns of these compositions confirm the formation of the single phase spinel structure. The lattice parameter calculated from XRD data is noted with increase in Ti^{4+} content. The values of bulk density, X-ray density and porosity are also calculated. The X-ray density is found to be higher than bulk density. The variation of bulk density and porosity is found in good agreement with each other. The values of porosity for different Ti contents are in the range 15-19%. The microstructural investigation using Scanning Electron Microscope shows that the grain size decreases with increase in Ti content expect for $x=0.02$. The grain size decreases from 18.9 μm to 10.9 μm . The magnetic properties are obtained from vibrating sample magnetometer (VSM) at room temperature. The coercivity (H_c), saturation magnetization (M_s) and remanent magnetization (M_r) are calculated for different amount of Ti content.

1.14 Synthesis and magnetoelectric characterization of Sr-Substituted Ni-Zn Ferrites

F. M. Kamal, 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

Objective: The objective of the work is to synthesis and magnetoelectric characterization of Sr-Substituted Ni-Zn Ferrites

Current progress: Spinal type polycrystalline $Ni_{0.6}Zn_{0.4}Sr_xFe_2O_4$ ($x=0.0, 0.05, 0.10, 0.15$ and 0.20) ferrites are synthesized by solid state reaction method. All the samples are sintered at 1250°C for 3 hours by using Muffle furnace, X-ray diffraction (XRD), scanning electron microscope (SEM), impedance analyzer and a vibrating sample magnetometer (VSM) utilized in order to study the effect of Sr^{2+} substitution in $Ni_{0.6}Zn_{0.4}Fe_2O_4$ and their impact on the crystal structure, surface morphology, electrical and magnetic properties, Two secondary phases Sr_2FeO_4 and $SrFe_{12}O_{19}$ are present in the XRD pattern for higher concentration of Sr (0.15 and 0.02). An increase in lattice constant is observed with the increase of Sr^{2+} content in the lattice. The density of the samples is found to decrease whereas porosity increases with the substitution of Sr^{2+} ions. Microstructural investigation by using scanning electron microscope shows that the grain size is increased with the increase of Sr content but the grain size is undermined for the sample with Sr $x=0.05$. The observed variation in M_s can be explained in terms of cation redistribution between A- and B- sublattices. Magnetic hysteresis is investigated at room temperature.

1.15 Synthesis and Characterition of Hydroxyapatite and Cobalt Ferrite nanocomposite for Biomedical application

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. A. Hossain*

Objective: The objective of the work is to synthesis and characterition of hydroxyapatite and cobalt Ferrite nanocomposite for biomedical application

Current progress: Hydroxyapatite is mostly applied in medical applications for repair or replacement of bone tissue in body system. Pure hydroxyapatite (HAP) have been synthesized by wet chemical precipitation method by using calcium nitrate $Ca(NO_3)_2 \cdot 4H_2O$ and diammonium hydrogen phosphate $(NH_4)_2HPO_4$. However, hydroxyapatite material shows relatively bad mechanical properties than natural bone and as such,

improvement of mechanical properties is necessary. One of the best candidate materials for the reinforcing phase to HAP is Cobalt Ferrite, which exhibits biocompatibility. A composite of Hydroxyapatite (Hap) and Cobalt ferrite (CoFe_2O_4) has application potential in bone tissue regeneration and heavy metal adsorption. In this present work, the nanostructured CoFe_2O_4 /Hap weight ratios from 4-8 wt%. The XRD results indicated no other impurity phase formations, illustrating the stability of the occurred Hap and CoFe_2O_4 phases. Phase fractions of CoFe_2O_4 were found to increase from 12.12 to 22.38wt% with increasing CoFe_2O_4 . FTIR results revealed the interaction of Hap and CoFe_2O_4 structure in composite ceramics, further supported with varying of the lattice parameter and the crystallite size. Magnetization of composite was increase from 0.26 to 2.08 emu/g with increasing CoFe_2O_4 . SEM results revealed Nano-sized morphology with the enhancement of porosity and interconnectivity when increasing CoFe_2O_4 .

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

1.16 Synthesis, Structure and Optical Properties of Magnetium Substituted Cobalt Nano-Ferrite/ Polybenzoxazine Composite

M. N. I. Khan, 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. Zaheen *

Objective: The objective of the work is to synthesis, structure and optical properties of magnetium substituted Cobalt Nano-Ferrite/ Polybenzoxazine composite

Current progress: Co-precipitation method has been utilized to obtain pure required compositions without unwanted phases of $\text{Mg}_{1-x}\text{Co}_x\text{Fe}_2\text{O}_4$ where $x=0.5-1$. MgFe_2O_4 and CoFe_2O_4 ferrites both belong to the inverse spinel structure can also be written as $(\text{Fe}^{3+})[\text{Mg}^{2+}_{1-x}\text{Co}^{2+}_x\text{Fe}^{3+}]_2\text{O}_4$. The Mannich condensation synthesis followed by heat curing, yield a pure polymer called benzoxazine monmer (BZ) and mixing of certain amount of ferrites and then heating the mixture the composites are formed, X-ray diffraction (XRD), TEM studies have been utilized to ensure formation of polymer, spinel and composite. With increases due to higher radius of cobalt. From TEM we can get that due to coating with PBZ polymer the agglomeration of particle decreases and increasing cobalt content in $\text{Mg}_{1-x}\text{Co}_x\text{Fe}_2\text{O}_4$ /PBZ composite. This combination has not been researched yet and is supposed to be suitable for many partial applications such as Heterogeneous catalysis, sensors, photoelectrical, magnetic technologies, magnetic resonance imaging, drug transport, microwave absorption, permanent magnet production, data storage.

* Department of Materials and Metallurgical Engineering, BUET, Dhaka

1.17 Synthesis & Characterization of Oxide Double Perovskite Ba_2BiVO_6 for Solar Cell Applications

M. N. I. Khan S. Manjura. Hoque, M.M. Haque, M.R. Hasan, A. Nahar, A. Parveen, A. A. Begum, N. Islam, N. Begum, M. A. Kayum, A.K.M. S. H. Faysal *

Objective: The objective of the work is to synthesis & characterization of oxide double perovskite Ba_2BiVO_6 for solar cell applications

Current progress: Organic-inorganic hybrid halide perovskites (OIHPs) have been a leading candidate in a solar cell research as potential materials, but they have major intrinsic drawbacks like instability and Pb-toxicity. Other halide based double perovskites have also been extensively studied, but face similar problems. In this regard, oxide double perovskites, which were previously studied mostly for their ferroelectric and magnetic properties, show great promise. These materials have similar photovoltaic application potentials, without the drawbacks of halide double perovskites. Here, the oxide double perovskite Ba_2BiVO_6 has been synthesized using solid-state reactions and characterized with this end in view. The powder X-ray diffraction spectrum confirms the formation of crystalline Ba_2BiVO_6 . An optical band gap of 2.58 eV has been obtain from UV-vis spectroscopy, which is promising for visible light absorption. FTIR and Raman analyses confirm the chemical bonds and vibrational modes of the material. SEM analysis has been used to study the surface morphology. Temperature depend and frequency dependent dielectric measurements have been done to study the dielectric properties of the material. The promising optical characteristics of Ba_2BiVO_6 can be further studied from Ba_2BiVO_6 nano particles.

* Department of Electrical and Electronic Engineering university of Dhaka, Dhaka

1.18 Synthesis & Characterization of Structural, Magnetic, Electrical and Optical Properties of $\text{Ca}_{0.9}\text{Sr}_{0.1}\text{Mn}_{1-x}\text{Mo}_x\text{O}_3$ Ceramics

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

Objective: The objective of the work is to synthesis & characterization of structural, magnetic, electrical and optical properties of $\text{Ca}_{0.9}\text{Sr}_{0.1}\text{Mn}_{1-x}\text{Mo}_x\text{O}_3$ ceramics.

Current progress: The Polycrystalline $\text{Ca}_{0.9}\text{Sr}_{0.1}\text{Mn}_{1-x}\text{Mo}_x\text{O}_3$ ceramics were prepared by the standard solid-state reaction method. The CaMnO_3 deserve special attention in the context of developing alternative n-type in solar cells due to the high affluence, environmental friendliness and the low cost. All the samples have been pre-sintered at 800°C for 3 hours and sintered at 1300°C for 4 hours respectively. Structural and compositional analysis were characterized by X-ray diffraction. The XRD patterns confirmed the phase transformation of orthorhombic structure for 0% to 4% Mo dopant contents to tetragonal structure for 6% to 8% Mo dopant with a very few impurity peaks. The magnetic and electrical properties had been carried out from the measurements of the permeability, M-H curves, magnetic loss factor, Relative Q-factor, dielectric constant, dielectric loss factor, resistivity and ac conductivity. Crystallite sizes were found at a range of 34 nm to 31 nm. The maximum value of permeability was observed for $x=0.06$ which means to good magnetic property can be obtained from 6% Mo doped samples. The M-H curves revealed the paramagnetic with weak ferromagnetic behavior at low temperature (5k). FTIR spectroscopy study showed the presence of vibration of M-O and M-O-M bonds around 661,583 and 402 cm^{-1} indicates the formation of phase CaMnO_3 .

* Department of Physics, Cumilla University, Cumilla

1.19 Study of Structural, Optical, Magnetic and Electrical Properties of Ni doped $\text{Ba}_{0.95}\text{Ca}_{0.05}\text{TiO}_3$ Ceramics

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

Objective: The objective of the work is to study of structural, optical, magnetic and electrical properties of Ni doped $\text{Ba}_{0.95}\text{Ca}_{0.05}\text{TiO}_3$ ceramics

Current progress: The structural, optical, magnetic and electrical properties of the perovskite material $\text{Ba}_{0.95}\text{Ca}_{0.05}\text{Ti}_{1-x}\text{Ni}_x\text{O}_3$ were investigated. The solid-state reaction method was followed to create the perovskite material, with Ca as the A-site dopant and Ni as the B-site dopant. The tetragonal structure of perovskite was observed using an XRD profile. Crystallite size was found at a range of 16nm to 21nm using the Scherrer Formula. The optical energy band-gap and metal-oxygen bonds in the perovskite structure are investigated by analyzing data from UV-VIS and FTIR respectively. A VSM was employed to investigate M-H loops at room temperature and found that the M-H curves reveal weak ferromagnetic behavior of Ca and Ni doped BaTiO_3 ceramics. High values of AC resistivity (ρ) and impedance (Z) at lower frequencies indicated higher polarization. AC conductivity (σ_{AC}) improve linearly with an increased frequency indicating small polaron hopping is present in the conduction mechanism. The optimum content of dopant for this perovskite material can be found based on the investigated magnetic, dielectric and electrical properties. Therefore it can be noted that the perovskite material $\text{Ba}_{0.95}\text{Ca}_{0.05}\text{Ti}_{1-x}\text{Ni}_x\text{O}_3$ will be a promising template for practical application in high- performance lead free devices such as capacitors and transducers.

* Department of Physics, Comilla University, Cumilla

1.20 Synthesis & Characterization of the Structural, Magnetic and Transport Properties of Mn Doped Ba-Sr-Ca Titanate Ceramic Materials for Spintronic Device Application

M. N. I. Khan, S. Manjura Hoque, H. N. Das, R. Rashid, M. R. Hasan, A. Parveen, A. A. Begum, M. A. Hossain, Z. Begum, R. T. Meem *

Objective: The objective of the work is to synthesis & characterization of the structural, magnetic and transport properties of Mn doped Ba-Sr-Ca titanate ceramic materials for spintronic device application

Current progress: The polycrystalline $\text{Ba}_{0.6}\text{Sr}_{0.3}\text{Ca}_{0.1}\text{Mn}_x\text{Ti}_{1-x}\text{O}_3$ has been successfully produced using manganese doping material, with different percentages of moles of manganese being used in the solid state reaction technique and sintered at 1250°C for 4 hours. The structural, magnetic, optical and transport

properties of Mn doped Ba-Sr-Ca titanate ceramic materials of all sample were investigated. The X-ray diffraction analysis revealed that the composition had a phase shift from cubic to tetragonal for last doping sample ($x=0.20$). Substitution of Mn^{2+} decreased the lattice parameter and crystalline size increased for $x=0.00$ to 0.10 , then decreased with the structural, magnetic and transport properties of Mn doped Ba-Sr-Ca titanate ceramic materials the doping concentration. The absorption bands for the composition were observed by FTIR. Raman spectra of BSCMT was analyzed by Raman spectroscopy and provided molecular structure of the material. The magnetic hysteresis loop (M-H loop) was observed by VSM provided the information of ferromagnetic ordering. Coercivity steadily rises for $x=0.00-0.05$ concentrations and then falls for $x=0.10-0.15$ concentrations, with improved coercive characteristics. The ceramic materials exhibit dielectric properties with the frequency range of 100 Hz to 100 MHz . Higher value of dielectric constant and other dielectric properties was observed for $x=0.10$. The synthesized ceramics are promising for tunable capacitor, disc drivers, loudspeakers, microphone mainly spintronic device applications.

* Department of Physics, Jahangirnagar University, Saver, Dhaka

1.21 Enhancement of Multiferroic Properties of Iron (Fe) Based Barium Titanate ($BaTiO_3$) Ceramics with Yttrium (Y) Substitution for Device Application

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

Objective: The objective of the work is to enhancement of multiferroic properties of iron (Fe) based Barium Titanate ($BaTiO_3$) ceramics with Yttrium (Y) substitution for device application

Current progress: The Polycrystalline perovskite ceramic of $Ba_{1-x}Y_xFe_{0.025}Ti_{0.975}O_3$ were produced for different Y concentration. and sintered at 1250°C for four hours. The XRD patterns of all the samples confirmed the cubic perovskite structures except for $x=0.10$, which displayed distorted phase shift cubic structure to tetragonal structure. Data from XRD was used to calculate the crystallite size, bulk density, X-ray density and porosity. The analysis of magnetic properties as a function of frequency showed that the permeability and relative Q factor is highest for $x=0.10$ of $Ba_{1-x}Y_xFe_{0.025}Ti_{0.975}O_3$ ceramic sample. The existence of $O=C=O$ stretching and $O-H$ bending in all the samples is confirmed by FTIR analysis. The frequency dependent electric properties investigation in the frequency range 100Hz to 1 MHz have shown that the real and imaginary components of the dielectric constant as well as dielectric loss and relative Q factor increase in low frequency zone and decrease in the high frequency region, resistivity. For 7% Y doping, the highest dielectric constant is seen. The highest and lowest values are recorded for both frequency-dependent reactance and impedance at 2% and 7% doping, respectively. Phase shift from cubic to distorted tetragonal at $x=0.10$ doping concentration is confirmed by Raman spectroscopy analysis.

* Department of Physics, Jahangirnagar University, Saver, Dhaka

1.22 Synthesis and Structural, Optical, Magnetic Characterization of Co doped $Ba_{0.9}La_{0.1}Ti_{(1-x)}Co_xO_3$ Perovskite

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

Objective: The objective of the work is to synthesis and structural, optical, magnetic characterization of Co doped $Ba_{0.9}La_{0.1}Ti_{(1-x)}Co_xO_3$ perovskite

Current progress: Lanthanum and Cobalt doped barium titanate were prepared by solid state reaction method. 10% La was fixed in A site while Co concentration varying with Ti in B site of $Ba_{0.9}La_{0.1}Ti_{(1-x)}Co_xO_3$. All the samples were sintered at 1250°C for 3 hours. The formation and variation of phase, homogeneity, crystal structure, lattice constant, density, tetragonality, and porosity with doping concentration was carried out by XRD analysis. XRD confirms its tetragonal structure and the calculated peaks are well matched with the peak of $BaTiO_3$ of ICDD database. To study the impact, a Fourier transformation infrared spectroscopy (FTIR) experiment was carried out. FTIR analysis reveals absorption bands in the region of 518 cm^{-1} and 356 cm^{-1} corresponding to Ti-O stretching (ν_1) and bending vibrations (ν_2), respectively, confirming the formation of TiO_6 octahedron. The UV-visible spectra confirms that the absorbance was varied with doping concentration and there was no absorption peak in the visible region but strong absorption observed in the ultraviolet region. Magnetic properties, M-H hysteresis loop was carried out through Vibrating Sample Magnetometer (VSM)

intwofixed different temperature while magnetic field was varied. It's revealed that in low temperature saturation didn't occur while in high temperature saturation magnetization carried out.

* Department of Electrical and Electronic Engineering (EEE), University of Chittagong, Chittagong

1.23 A Systematic Study of Structural and Luminescence Properties of ZnLiBO_3 for Thermoluminescence Dosimetry Applications

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

Objective: The objective of the work is systematic study of structural and luminescence properties of ZnLiBO_3 for thermoluminescence dosimetry applications

Current progress: Zinc Lithium Borate TLD material is synthesized by a simple, environmentally friendly high-temperature solid-state reaction methods. The crystalline structure of the phosphor was confirmed by XRD analysis. Lattice parameters, unit cell volume, grain size, dislocated density and micro strain were calculated from XRD data. Molecular bounds, vibrations, identity, and micro structure of the investigated materials were collected by using Raman and FTIR. Importantly, the TL characteristics were reported by photon energy (6 MV) and electron energy (6 MeV) radiation for the dose range from 0.5 to 8 Gy. It is found that the TL dose response of the ZnLiBO_3 polycrystalline sample to photon energy radiation in the range from 0.5 to 8 Gy for radiation processing dose level is almost linear. The TL studies of the ZnLiBO_3 sample show that they consist of two peaks around 157°C for the first peak and 240°C for the second peak for photon energy radiation and 161°C for first peak and 229°C for second peak for electron energy radiation. These glow peaks show great stability for a long time (28 days). High sensitivity was exhibited by the new crystalline material for both photon energy and electron energy and most sensitive for 8 Gy. Minimum detectable dose was found 40 mGy for photon energy and 42.5 mGy for electron energy.

* Department of Begum Rokeya University, Rangpur

1.24 Syntesis and Investigation of Structural and Thermoluminescence Properties of LiCaPO_4 Phosphor for TL Radiation Dosimetry Applications

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

Objective: The objective of the work is synthesis and investigation of structural and thermoluminescence properties of LiCaPO_4 phosphor for TL radiation dosimetry applications

Current progress: LiCaPO_4 phosphor is synthesized using modified solid-state diffusion method. To obtain the pure phase of LiCaPO_4 , the temperature is maintained below 800°C in every step. XRD analysis confirmed the phase purity of the phosphor with rhombohedra structure. Lattice parameters, unit cell volume, grain size, dislocated density and microstrain were also calculated from the XRD data. Raman analysis and FTIR analysis were used to collect information about molecular bonds, vibrations, identity and structure of the phosphor. To investigate thermoluminescence properties and kinetic parameters, the phosphor is irradiated with a linear accelerator which produces 6.0 MV (photon energy) 6.0 MeV (electron energy) for doses ranging from 0.5 Gy to 6.0 Gy. For both photon and electron energy, TL glow curves show two identical peaks near to 200°C and 240°C. Kinetic parameters such as geometric factor (μg), order of kinetics, activation energy (E), frequency factor (s) are obtained from chen's peak shape method. The dose against the thermoluminescence intensity curve shows the phosphor is almost linear to the dose. For photon energy, the phosphor is found to be most sensitive for 2.0 Gy, and for electron energy, the phosphor is found to be most sensitive for 4.0 Gy. The phosphor has very low fading and after 28 days it shows only 3% fading.

* Department of Begum Rokeya University, Rangpur

1.25 Syntesis and Characterization of Zinc and Yttrium doped Lithium Magnesium Borate for Thermolumiscence Dosimetry

M. Al-Mamun, M. N. I. Khan, S. Manjura Hoque, H. N. Das, R. Rashid, M. R. Hasan, A. Parveen, A. A. Begum, M. A. Hossain, Z. Begum, M. N.I Hasan, F. Yousuf, M.. S. Siddique *

Objective: The objective of the work is syntesis and characterization of Zinc and Yttrium doped Lithium Magnesium Borate for thermolumiscence dosimetry

Current progress: Lithium Magnesium Borate doped with varying concentrations of ZnO and Y₂O₃ was synthesized by Solid-state diffusion method. The undoped and doped Lithium Magnesium Borate were characterized using XRD and FTIR and the pattern was matched with reference patterns to verify the formation of LMB and showed the crystalline nature which confirmed the monoclinic crystal structure. The FTIR spectra of synthesized samples were studied to indicate the presence of BO₃, BO₄ and B-O-B functional groups. For ZnO and Y₂O₃ doped LMB, vibration of metal cation Zn²⁺ and Y-O stretching modes were also present in the spectrum. Key dosimetric properties were also investigated including glow curve, sensitivity and dose response. Doped LMB samples showed non-linear dose response within the dose range of (8-36) Gy. Kinetic parameters such as the activation energy and the frequency factor were also calculated using the initial rise method. Maximum activation energy was found 0.777943 eV in the 0.9 mol% Yttrium Oxide doped LMB and maximum frequency factor was found $2.20123 \times 10^{20} \text{ s}^{-1}$ in the undoped LMB at a relatively lower temperature. This strongly indicated that the trapped electrons in the undoped LMB were released much faster at a lower temperature with a lower activation energy, while the contrary was found for the doped LMB.

* Department of Nuclear Science and Engineering Military Institute of Science and Technology, Dhaka

1.26 Synthesis and Characterization of Graphene Oxide Reinforced Cobalt Doped Bismuth Titanate Nanocomposites

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

Objective: The objective of the work is synthesis and characterization of Graphene Oxide reinforced Cobalt doped Bismuth Titanate Nanocomposites

Current progress: Graphene oxide (GO) was synthesized by modified hummers method and bismuth titanate (BTO) was prepared in two different processes: the pechini method and sol-gel method. The XRD analysis confirmed a perfect preparation of GO nanocomposites and BTO nanocomposites indicates the orthorhombic structured perovskite phase. Then cobalt has been doped in BTO nanocomposites in the ratio 10%, 30% and 50% by sol-gel process which is better from pechini method. The structural distortion of CBTO was due to the difference between the radii of Co dopants and Ti hosts. After comparing their properties, we choose 10% CBTO for GO reinforcement. Crystal size, dislocation density, micro-strain, lattice parameters, miller indices, and volume of all composites were measured from XRD data. FTIR analysis identified all the vibrational bonding and revealed the presence of all the functional groups for which the composite may be able to remove dyes in industrial arrangements. The XRD and FTIR analysis confirmed the incorporation of CBTO nanocomposites into the GO matrices without altering its orthorhombic structure and perovskite phase. The magnetic properties of all composites were studied by the PPMS system where GO-CBTO composites showed soft magnetic nature which is able to filter the heavy metals from the aqueous solution.

* Department of Physics, Khulna University, Khulna

1.27 Characterization of Nickel Doped Bismuth Ferrite and Multiwalled CNT Nanocomposites Synthesized by Hydrothermal Method

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

Objective: The objective of the work is characterization of Nickel Doped Bismuth Ferrite and Multiwalled CNT Nanocomposites synthesized by hydrothermal method

Current progress: Structural and optical properties of sillenite type Ni substitute bismuth ferrite and nanocomposites of BNF-Multi-walled carbon nanotubes (MWCNT) has been investigated. Sillenite-type BNF-Multi-walled were synthesized by hydrothermal method at different reaction temperatures. Then MWCNT were incorporated with synthesized BNF nanocomposites by hydrothermal method to form BNF@MWCNT nanocomposite. In the nanocomposites BNF (with 50% Ni) different weight ratios of MWCNT were added then synthesized BNF@MWCNT nanocomposites are characterized by XRD, FTIR, UV-Vis SRS. The XRD measurements confirmed the formation of perovskite-type BiFeO₃ at the lowest reaction temperature of 200°C and structural transition from sillenite-type Bi₂₅FeO₄₀ to perovskite-type BiFeO₃ was observed. The UV observation revealed that the presence of Ni atom in the Bi₂₅FeO₄₀ crystal changed the band gap of pure Bi₂₅FeO₄₀ is 2.10 eV to 2.24 eV, 2.27 eV and 2.29 eV for 10%, 30% and 50% Ni concentration respectively. The band gap of synthesized composites are 2.19 eV, 2.09 eV, 1.97 eV, 2.21 eV, 2.05 eV, 2.09 eV for F1%CS,

F3%CS, F5%CS, F1%CI, F3%CI, F5%CI respectively. The crystallite size of Pure $\text{Bi}_{25}\text{FeO}_{40}$ is 34.89 nm and composite of F1%CS, F3%CS, F5%CS, F1%CI, F3%CI, F5%CI having crystallite size are 32.21 nm, 31.05 nm, 28.04 nm, 31.44 nm, 31.71 nm, 29.58 nm.

* Department of Physics, Khulna University, Khulna

2. Training Course Organized and Seminar Arranged

Sl. No.	Title	Date	Place	No. of participant
1	1 st International Dhaka Science Conference for Women-WSTC-2023	15-16, February, 2023	Hotel Pan Pacific Sonargaon, Dhaka	150
2	International Conference on Electronics and Informatics 2022	26-28 January, 2023	AECD	120
3	National Conference on Physics, 2023	9-11 March, 2023	Jahangirnagar University, Saver	240

3. Seminar/Symposium/Conference/Workshop Attended

Name of the person	Title of the event	Organizer	Date	Place
Dr. Engr. Sheikh Manjura Hoque	International Conference on Electronics and Informatics 2022	BES	26-28 January 2023	AECD
	1 st International Dhaka Science Conference for Women-WSTC-2023	Dhaka Nanomaterials Group BAN:02/2, ISP, Uppsala University, Sweden	15-16 February 2023	Hotel Pan Pacific Sonargaon, Dhaka
	National Conference on Physics, 2023	BPS	9-11 March 2023	Jahangirnagar University, Saver,
Engr. Faizul Mohammad Kamal	International Conference on Electronics and Informatics 2022	BES	26-28 January 2023	AECD
	National Conference on Physics, 2023	BPS	9-11 March 2023	Jahangirnagar University, Saver
Dr. Md. Mahbubul Haque	International Conference on Electronics and Informatics 2022	BES	26-28 January 2023	AECD
	National Conference on Physics, 2023	BPS	9-11 March 2023	Jahangirnagar University, Saver
Dr. Mohammad Nazrul Islam Khan	International Conference on Electronics and Informatics 2022	BES	26-28 January 2023	AECD
	1 st International Dhaka Science Conference for Women-WSTC-2023	Dhaka Nanomaterials Group BAN:02/2, International Science Program, Uppsala University, Sweden	15-16 February 2023	Hotel Pan Pacific Sonargaon, Dhaka
	National Conference on Physics, 2023	BPS	9-11 March 2023	Jahangirnagar University, Saver
Dr. Md. Al-Mamun	International Conference on Electronics and Informatics 2022,	BES	26-28 January 2023	AECD

	National Conference on Physics, 2023	BPS	9-11 March 2023	Jahangirnagar University, Saver,
Dr. Harinarayan Das	International Conference on Electronics and Informatics 2022,	BES	26-28 January 2023	AECD
	1 st International Dhaka Science Conference for Women-WSTC-2023	Dhaka Nanomaterials Group BAN:02/2, International Science Program, Uppsala University, Sweden	15-16 February 2023	Hotel Pan Pacific Sonargaon, Dhaka
	National Conference on Physics, 2023	BPS	9-11 March 2023	Jahangirnagar University, Saver
Dr. Engr. Rimi Rashid	International Conference on Electronics and Informatics 2022,	BES	26-28 January 2023	AECD
	1 st International Dhaka Science Conference for Women-WSTC-2023	Dhaka Nanomaterials Group BAN:02/2, ISP, Uppsala University, Sweden	15-16 February 2023	Hotel Pan Pacific Sonargaon, Dhaka
	National Conference on Physics, 2023	BPS	9-11 March 2022	Jahangirnagar University, Saver
Samia Islam Liba	International Conference on Electronics and Informatics 2022	BES	26-28 January 2023	AECD
Md. Razibul Hasan	International Conference on Electronics and Informatics 2022	BES	26-28 January 2023	AECD
	National Conference on Physics, 2023	BPS	9-11 March 2023	Jahangirnagar University, Saver
Arijun Nahar	International Conference on Electronics and Informatics 2022	BES	26-28 January 2023	AECD
Arup Kumar	International Conference on Electronics and Informatics 2022	BES	26-28 January 2023	AECD
	1 st International Dhaka Science Conference for Women-WSTC-2023	Dhaka Nanomaterials Group BAN:02/2, ISP, Uppsala University, Sweden	15-16 February 2023	Hotel Pan Pacific Sonargaon, Dhaka
	National Conference on Physics, 2023	BPS	9-11 March 2022	Jahangirnagar University, Saver

4. Stakeholder Meeting

A meeting has been arranged with the stakeholders to extend support to the industry and academia in order to utilize the facilities available in this division, Materials Science Division dated 08.06.2023 and 18 Person people have been attended the meeting.

5. Collaboration Work

To improve the research quality, Materials Science Division is involved with a collaboration work titled on Magnetic and structural properties of Ferrites, Nanocomposites and Perovskite Materials with International Program for Physical Sciences (IPPS) under International Science Program of Uppsala University, Sweden.

On the other hand, to help in the development of manpower, this division is involved with the preparation of question paper, evaluation of examination paper, evaluation of thesis paper in the level of M.S./M.Phil./Ph.D. at different public Universities in the country.

This division is also involved with the collaboration research work with different public and private Universities in the country.

6. Service Rendered

6.1 Service Provided by XRD

Name of the month	Name of institutions/organizations	Name of samples	Number of samples
July 2022	Dept. of Chemistry, BRUR	Magnetic Polymer Composite	02
	Dept. of BMB, DU	Jute	03
	Dept. of Physics, BUET	BiLaFe ₂ O ₃	01
	Dept. of Physics, BUET	CuCO ₂ S ₄	01
	Dept. of BMB, DU	Jute	03
	Dept. of Chemistry, KU	GO	01
	Dept. of Chemistry, KU	Powder	06
	Dept. of Civil Engineering, CUET	Soil	10
	SK+F Pharmaceuticals' Ltd.	Cellulose	02
	Dept. of Chemistry, JNU	TiO ₂	02
	Dept. of GCE, BUET	Glass Powder	01
	Dept. of Physics, BUET	CuCO ₂ S ₄ -MoS ₂	01
	Dept. of Physics, BUET	BiFeO ₃	01
August 2022	ACI Pharmaceuticals, Ltd	Lefamulin Acetate	01
	Dept of Chemistry, JNU	Jute	04
	Dept of Chemistry, JNU	rGO	03
	Dept. of Physics, DU	Thin Film	03
	Dept. of GCE, BUET	Cement	02
	Dept. of Textile Engineering, JUST	Fabric	08
	Dept of BMB, RU	Hibiscus (Petal)	01
	Dept. of GCE, BUET	Cement	01
	Dept. of GSB	Hard Rock	31
	Dept. of BMD, DU	Jute	01
	Dept. of Physics, BUET	CuCO ₂ S ₄	01
	PI, DU Centennial Research Grant STRC, DU	Nanoparticles	10
	PI, DU Centennial Research Grant STRC, DU	Nanoparticles	04
	Dept. of MME, BUET	MgCaSn Alloy	01
	Dept. of MME, BUET	Flag	03
	Dept. of EEE,IU, Kustia	Nanoparticles	01

Name of the month	Name of institutions/organizations	Name of samples	Number of samples
September 2022	MS, Bismillah auto R.N. Road, Jessore	Motor Parts	02
	Dept. of MME, BUET	Ferrite	02
	Eskayef Pharmaceuticals Limited	Veriguat	01
	Dept. of MME, BUET	Bismuth Ferrite	01
	Dept. of Chemistry, BRUR	Activated Carbon & Iron Oxide	02
	Dept. of MME, BUET	TiO ₂	04
	Dept. of NCE, BUET	Cement	02
	Dept. of MME, BUET	CuO	07
	Dept. of Chemistry, KU	Nanoparticles	01
	Dept. of Chemistry, KU	Ferrite	02
	Dept. of Chemistry, KU	Ferrite	02
	Dept. of Chemistry, BUET	Nano Composite	02
	Dept. of Chemistry, KU	TG,TC,GB	04
October 2022	Dept. of Physics, BUET	POMA	01
	Dept. of Chemistry, DU	Ca-Mg-Ba- Sr +Guaunine Comple	02
	Dept. of Chemistry, RU	Nano Composite	04
	BUTEX	Ferrite	04
	Dept. of Civil Engg, CUET	Fly Ash	01
	Dept. of ACCE, NSTU	Zeolite	01
	Dept. of ME, DUET	Composite Materials	05
	Dept. of Physics, BUET	CoFe ₂ O ₄ & CuCo ₂ S ₄	02
	SKF Pharmaceuticals Limited	Ritonavir	01
	Dept. of Physics, BUET	Nano Composite	05
	Dept. of Physics, BUET	La doped BiFe ₂ O ₄ & MoS ₂	02
	SKF Pharmaceuticals Limited	Osimeitinib Mesylate	02
November 2022	Linde Bangladesh Ltd.	Ferrite Silicon & Manganese	04
	Dept. of MME, BUET	Magnesium	03
	Dept. of MME, BUET	BiFeO ₃	02
	Dept. of Chemistry, BUET	TiO ₂ F+WO ₃	01
	Dept. of EEE, IU	Silver	01
	Dept. of Physics, BUET	BFO & CFO-TiO ₂	02
	Dept. of ME, DUET	Graphene	07
	Dept. of MME, BUET	BaTiO ₃	01
	Dept. of BUTEX	Jute	03
	Dept. of Physics, DUET	Ferrite	03
	Dept. of MME, BUET	TiO ₂	01
	Dept. of MME, BUET	LNMO	01
	SKF Pharmaceuticals Limited	Abemaciclib	02
	Dept of Physics, CoU	Ferrite	06

	Dept of Physics, CoU	Composite	06
	Institute of Environment Science, RU	Nanoparticle	03
	Dept. of ME, BUET	Membrane	04
December 2022	Dept. of Chemistry, RU	Polymeric Composite	02
	Dept of Physics, DU	Nanoparticle	04
	Dept. of ESDM, NSTU	Adsorbent	02
	Dept. of Chemistry, RU	Nano Composite	05
	Dept. of MME, BUET	Ferrite	01
	Dept of Physics, DU	Composite	01
	Dept. of MME, BUET	Cellulose	01
	Dept. of MME, BUET	Mg Alloy	03
	Dept. of Chemistry, JU	Iron Complex	02
	Dept. of Physics, BUET	Composite	01
	Dept. of LBJM	Cellulose	01
	Mg Alloy	Mg Alloy	03
	Dept. of Chemistry, RU	Iron Complex	02
	Mg Alloy	Mg Alloy	03
January 2023	SK+F Pharmaceuticals Ltd	Brigatinib	01
	Dept. of ChE, JUST	TiO ₂	10
	Dept. of Chemistry, BUET	MnV ₂ O ₄	01
	Dept. of Chemistry, BUET	BaCl ₂ & SrCl ₂	02
	Dept. of Soil Science, CU	Soil	26
	Dept. of MME, BUET	CuO	01
	Dept. of MME, BUET	TiO ₂	01
	Dept. of Chemistry, RU	Polymer Nano Composite	01
	Dept. of Soil Science, CU	Soil	26
	Dept. of MME, BUET	CuO	01
	Dept. of MME, BUET	TiO ₂	01
	Dept. of Chemistry, RU	SiO ₂	01
	Dept. of MME, BUET	Mg Zn Gd Alloy	03
	Dept. of Physics, BUET	CsSnBr ₃	01
	Dept. of Chemistry, RU	Polymer Nano Composite	01
February 2023	Dept. of Chemistry, RU	ZnO & Activated Carbon	01
	Dept. of Chemistry, RU	SiO ₂	01
	Dept. of TE, MBSTU	Silk Fibrin	01
	Dept. of MME, BUET	Mg Alloy	06
	SK+F Pharmaceuticals Ltd.	Vericiguat	01
	Dept. of Physics, BUET	MoS ₂	01
	Dept. of Physics, CUET	Ferrite	06
	Dept. of Physics, BUET	LaMnO ₃	01
	Dept. of EEE, DU	Thin Film	04
	Dept. of EEE, DU	Thin Film	04

	Dept. of Physics, BUET	CsSnBr ₃	01
	Dept. of Chemistry, RU	Polymer Nano Composite	01
	Dept. of Physics, BUET	ZnO & Activated Carbon	01
	Dept. of MME, BUET	TiAlC ₂	02
	Dept. of Chemistry, KU	GO	02
	Dept. of Chemistry, BUET	Fulvic Acid	02
	Dept. of Physics, BUET	CsSnClBr ₂	01
	Dept. of MME, BUET	Borosilicate & Quartz (CuO)	02
	Dept. of Pharmacy, KU	Chitosan, TTP	02
	Dept. of TE, BUET	Composite	01
	Dept. of Pharmacy, NSU	ZnFeGO	02
	Dept. of GFB, BSMRAU	Nano Particles	02
	Dept. of MME, BUET	Ti ₃ C ₂	01
March 2023	Dept. of ME, BUET	PLA-HA	04
	Dept. of Physics, BUET	MoS ₂	01
	Dept. of Physics, BUET	MnS	01
	Dept. of FSEE, BAU	Wood	04
	Dept. of Chemistry, RU	Polymer Nano Composite	01
	Dept. of Chemistry, BUET	Ni	01
	Dept. of TE, KUET	Composite	01
	SK+F Pharmaceuticals Ltd.	Exemestane USP	01
	Dept. of Physics, BUET	Nano Composite	01
	Dept. of Chemistry, RU	TiO ₂	04
	Dept. of Soil Science, CU	Soil	05
April 2023	Dept. of Chemistry, RU	Ag	01
	Dept. of Chemistry, RU	PVDF, PVDF-CA	02
	Dept. of MME, BUET	Trungsten	01
	SK+F Pharmaceuticals, Ltd.	Pregabalin	01
	Dept. of Chemistry, RU	20% Cellulose	05
	Dept. of Physics, BUET	Ag-PVA Nano Composite	01
	Dept. of Physics, BUET	CuO Nanoparticles	02
	Dept. of CE, IUBAT	Banana Leaf Fiber	02
	Dept. of CE, IUBAT	Hybrid Fiber	02
	Dept. of Physics, BU	GO Nano Composite	03
	Dept. of Chemistry, KU	Nanoparticle	05
	Dept. of MME, BUET	5% Nd doped thin film	01
	Dept. of Physics, BU	Thin Film	04
	Dept. of MPE, AUST	Glass Particles	01
	Dept. of Chemistry, KU	BiNPs	01
May 2023	Dept. of Chemistry, BUET	TiO ₂ , Biochar	03
	Dept. of MME, BUET	Thin film	03
	Dept. of Physics, BUET	BFO	04

	Dept. of MME, BUET	Ti ₃ C ₂	02
	Dept. of MME, BUET	CuO	02
	Dept. of MME, BUET	LaCaMnO ₃	01
	Dept. of ME, IUBAT	ZnO,Cu	02
	Dept. of ME, CUET	Cu ₂ O	06
	Dept. of MME, BUET	Thin Film	01
	Dept. of Physics, BUET	Cs ₃ Bi ₂ Br ₉	01
	Dept. of ME, DUET	Mg & Mg Alloy	08
	Dept. of MME, BUET	Al-Zn-Mg-Cu Alloy	02
	Dept. of MME, BUET	Thin Film Al, Co doped TiO ₂	05
	Dept. of MME, BUET	CuO Thin Film	01
	Dept. of Physics, BAU, Mymensingh	Wood	28
June 2023	Dept. of Physics, BUET	Perovskite Manganite	02
	Dept. of MME, , BUET	Nd. Doped CuO	03
	Dept. of Physics, BUET	Gd ₂ FeBiO ₆	01
	SK+F Pharmaceuticals Ltd.	Pregabalin	01
	Dept. of ME, CUET	PVA Composite	06
	Dept. of Physics, BUET	MgAlZnY	04
	Dept. of Physics, BUET	CuCo ₂ S ₄ -MoS ₂ -Na ₂ SO ₄	01
	Dept. of MME, RU	CuBi ₂ O ₄ MoS ₂	01
	Dept. of Physics, BUET	CuO Nano Particle	01
	Dept. of MME, , BUET	Mg Alloy	10
Total=			530

6.2 Service Provided by SEM & EDA

Name of the month	Name of institutions/organizations	Name of samples	Number of samples
August 2022	Dept. of Physics, JU	Alloy	01
	Dept. of Chemistry, BUET	Composite	03
September 2022	Dept. of Chemistry, BUET	Silver Titenium Composite	01
	Dept. of Cevil Engineering, CUET	Composites	03
Total =			08

6.3 Service Provided by TEM/FESEM

Name of the month	Name of institutions/ organizations	Name of samples	Number of samples
July 2022	Dept. of SUST	Nanoparticles	01
	Dept. of Chemistry, DU	Nanoparticles	01
	Dept. of Chemistry, DU	Nanoparticles	01
	Dept. of Chemistry, DU	Nanoparticles	01
	Dept. of Chemistry, DU	Nanoparticles	01
	Dept. of ACCU, DU	Bulk, GCNS,PGC, PGCC	04

Name of the month	Name of institutions/ organizations	Name of samples	Number of samples
August 2022	Dept. of Chemistry, BUET	Nanoparticles	01
	Dept. of DU	Nanoparticles	04
	Dept. of ANFT, IU, Kustia	Nanoparticles	20
	PI, DU Centennial Research Grant STRC, DU	Nanoparticles	04
	Dept. of MME, BUET	Nanoparticles	03
	PI, DU Centennial Research Grant STRC, DU	Nanoparticles	04
	Dept. of EEE, IU, Kustia	Nanoparticles	03
September 2022	Dept. of Chemistry BRUR	Poly styrene, PS/P(S-HEMA)Fe ₃ O ₄ , P(S-HEMA)Fe ₃ O ₄	03
	Dept. of Chemistry, JNU	Nanoparticles	01
February 2023	Dept. of Physics, BUTEX	Ferrite Nano Particles	08
March 2023	Dept. of Govt, Shaheed Suhrawardy Collage, Dhaka	Titanium Oxide Nanoparticle	03
April 2023	Dept. of ACCE, DU	TiO ₂ , B-Sn/TiO ₂	02
May 2023	Dept. of Chemistry, BUET	MnV ₂ O ₆	01
	Dept. of MME, BUET	MnO ₂ +WO ₃ +CuO	03
	Dept. of BGE, MBSTU	Nano Particles	08
	Dept. of MME, BUET	Polybenzoxazine + Co-Mg Ferrite	03
	Dept. of ACCE, DU	GCN	01
June 2023	Dept. of Chemistry, DU	Go-Fe-Co	01
	Dept. of Physics, BUET	Nano Particles	01
	Dept. of Physics, SUST	BiVO ₄	01
	Dept. of Pharmacy, NSU	Jute Extract	01
	Dept. of SUST	Ferrite	02
Total =			87

6.4 Service Provided by Raman Spectroscopy

Name of the month	Name of institutions/ organizations	Name of samples	Number of samples
August 2022	Dept. of Physics, BUET	BVO	03
December 2022	Dept. of DUET	Graphine	07
January 2023	Dept. of DUET	PVAF	04
March 2023	Dept. of Physics, BUET	MoS ₂	06
Total =			20

6.5 Service Provided by PPMS

Name of the month	Name of institutions/ organizations	Name of samples	Number of samples
January 2023	Dept. of Comilla University, Cumilla	Ferrite	05
	Dept. of Comilla University, Cumilla	Ferrite	04
	Dept. of Physics, DU	Nano Particle	06
	QAD, ACI Pharmaceuticals Ltd.	Clascoterone INNS Rimegepant Sulfate	02
	Dept. of Physics, Comilla University	Ferrite	04
February 2023	Dept of Chemistry, RU	Ferrite	02
	Dept. of Physics, CU	Ferrite	04
	Dept. of Chemistry, BRU	Nano Particle	01
May 2023	Dept. of Physics, BUET	Ferrite	08
	Dept. of MME, BUET	LaCaMnO ₃	05
	Dept. of Physics, BUET	Ferrite	01
June 2023	Dept. of Physics, BUET	Ferrite	01
	Dept of GCE, RUET	Nano Particles	03
	Dept. of Chemistry, RU	Ferrite	02
	Dept. of BCSIR	Ferrite	60
Total =			108

6.6 Service Provided by DSC/TGA

Name of the month	Name of institutions/ organizations	Name of samples	Number of samples
July 2022	Dept. of CHE, JUST	KaOlinite, TiO ₂	02
Total =			02

6.7 Service Provided by DLS Zeta Potential

Name of the month	Name of institutions/ organizations	Name of samples	Number of samples
July 2022	Dept. of BMB, DU	KaOlinite, TiO ₂	01
	Dept. of Pharmaceuticals Chemistry, DU	Zn, Cellulose	06
	Dept. of ANFT, IU, Kustia	Nanoparticle	10
	Dept. of EEE, IU, Kustia	Nanoparticle	05
	Dept. of Chemistry, RU	Nanoparticles	08
November 2022	Dept. of Pharmacy, NSU, Dhaka	PLG & Geletin	12
February 2023	Dept. of BJME, Dhaka	Cellulose	03
	Dept. of Pharmacy, NSU	Jute Extract	02
	Dept. of Pharmacy, NSU	Chitosan, TTP	02
	Dept. of Pharmacy, NSU	Papaya Extract	03
March 2023	Dept. of Pharmaceuticals Science,	Folic Acid	06

Name of the month	Name of institutions/ organizations	Name of samples	Number of samples
	NSU		
	Dept. of ME, CUET	Cu ₂ O	02
	Dept. of Pharmacy, NSU	Paclitaxel +FA+PE4	02
	Dept. of Chemistry, RU	TiO ₂ PvdF	03
May 2023	Dept. of Chemistry, RU	Fe ₃ O ₄	05
Total =			70

6.8 Service Provided by FTIR

Name of the month	Name of institutions/ organizations	Name of samples	Number of samples
July 2022	Dept. of BSME, IUBAT	MS	01
	Dept. of Chemistry, RU	Polymer	05
August 2022	Dept. of BSME, IUBAT	MS	01
	Dept. of Pharmacy, NSU	Papaya	01
	Dept. of Physics, RU	Ferrite	01
	Dept. of EEE,IU, Kustia	Nanoparticle	05
	Dept. of BSME	BFO	01
September 2022	Dept. of Chemistry, RU	TN, RON	12
October 2022	Dept. of Chemistry, JNU	GO	01
	Dept. of Mathematics & Physics, NSU	Ferrite	09
	BUTEX	Ferrite	04
	Dept. of Chemistry, RU	Bi	01
	Dept. of ME, DUET	Composite Materials	05
	Dept. of Physics, Feni University	CuAl	01
	Dept. of BSME, IUBT	Quartz	01
November 2022	Dept. of Chemistry, RU	Ron	09
	Dept. of ME, DUET	Graphane	07
	Dept. of ME, DUET	Silver	01
	Dept. of Chemistry, RU	Bismuth	01
	Dept. of ME, BUET	Membrane	04
December 2022	Dept. of ME, IUBAT	Zr Nanoparticle	01
	Dept. of Chemistry, RU	Composite Materials	04
	Dept. of NSU	Drug	04
	Dept. of Mathematical of Physics, NSU	Ferrite	06
January 2023	Dept. of Pharmacy, NSU	Drug Combination	02
	Dept. of Physics, DU	Ferrite	01
	Dept. of Chemistry, RU	Polymer Nano Composite	03
	Dept. of Chemistry, BUET	MnV ₂ O ₄	01
	Dept. of Chemistry, BUET	BaCl ₂ & SrCl ₂	05
	Dept. of ME, DUET	Silver	01
February 2023	Dept. of NSU	Jute Extract	01

Name of the month	Name of institutions/ organizations	Name of samples	Number of samples
	Dept. of Polymer Unit, BUET	Polymer	01
	Dept. of Chemistry, KU	GO	01
	Dept. of Pharmacy, NSU	Row Jute Extrsct	01
	Dept. of Chemistry, RU	Ferrite	01
	Dept. of GFB, BSMRAU	AUNPs & AgNPs	03
March 2023	Dept. of ME, DUET	PLA-Gr	01
	Dept. of Animal Science, BAU, Mymensingh	Cow Dung	04
	Dept. of Pharmaceuticals Science, NSU	Folic Acid	02
	Dept. of Chemistry, KUET	Cu ₂ O	02
	Dept. of BSME (IUBAT)	Titanium	01
	Dept. of TE, MBSTU	Fabric	01
	Dept. of Pharmacy, NSU	Paclitaxel+FA+PE4	01
April 2023	Dept. of Chemistry, RU	PVDF-CA	02
	Dept. of Polymer, BUET	Polymer	01
May 2023	Dept. of ME, IUBAT	ZnO	01
	Dept. of ME, DUET	Mg & Mg Alloy	08
	Dept. of ME, CUET	CSB	02
June 2023	Dept. of Physics, BUET	La _{0.65} Ba _{0.35-x} MnO ₃	02
	Dept. of ME, CUET	CuO, ZnO, MgO, TiO ₂ , Al ₂ O ₃ , Neat PVA	06
Total =			141

6.9 Service Provided by UV

Name of the month	Name of institutions/organizations	Name of samples	Number of samples
January 2023	Dept. of NSU	Drug	06
	Dept. of ME, IUBAT	Graphene	01
	Dept. of ME, IUBAT	Zr Nano Particle	01
February	Dept. of Pharmacy, NSU	Drug	02
March 2023	Dept. of Pharmacy, NSU	Papaya Extract	06
April 2023	Dept. of CUET	Leaf Extract	06
May 2023	Dept. of ME, IUBAT	Ferrite	01
Total =			23

Medical Physics Division, AECD

Objective

Medical Physics Division was established in 2014. The main objective of this division is to provide academic lead in research, training as well as service in the field of medical physics. The prime objectives are:

- To develop qualified medical physics professionals by organizing training courses on Medical Physics.
- To provide medical physics expert services in hospitals over the country to manage cancer patients.

The main programs under this division are:

- To develop well-qualified medical physicists (QMPs) and nuclear medicine technologists.

- To facilitate research work leading to MS/ MPhil/ PhD degrees and post doctoral research works with the affiliation of different Universities.

Activities:

1. Research and Development Work(s)

1.1 Dose Calculation and Verification of Different Planning Techniques using AAA Algorithm in the Lung Region

R. Khatun, S. Akter, A. N. Monika and L. Sharmin*

Dose optimization is very important for all kinds of treatment modalities. In radiotherapy practices it is of special interest, because it deals with the cancer patient. Algorithm validation and software testing of a dose calculation algorithm used in radiotherapy treatment planning system (RTPS) is a challenging job for to some extent, due to unavailability of proper dosimetry phantoms. The purpose of this research study is to calculate the dose in the lung region using Anisotropic Analytical Algorithm (AAA) and hence to find the percentage deviation by practical measurement using a homogeneous IMRT Thorax phantom. The 3D CRT, IMRT, and VMAT plan have been planned for 200 cGy by Eclipse (Version 13.7) planning system using AAA algorithm for 6 and 10 MV beam energies. All the plans have been delivered on the same phantom in the same setup condition, unlike CT simulation. The percentage deviation between the calculated and measured doses of 3D CRT, IMRT, and VMAT plan for 6 MV were 0.30%, 2.5%, and 0.15%. For 10 MV beams the deviations were 0.20%, 0.01%, and 1.41% respectively. Overall, the results showed a good agreement between calculations and measurements within 3% tolerance for the lung region. Thus, the CIRS- 002LFC phantom is a wonderful tool for point dose verification for all planning techniques.

* Department of Nuclear Engineering, University of Dhaka

1.2 Quality Assurance of High Dose Rate Brachytherapy Treatment Facility in Bangabandhu Sheikh Mujib Medical University (BSMMU)

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

Quality Assurance (QA) in the Brachytherapy treatment process is essential to ensure accurate dose delivery to the patient and minimize the possibility of accidental exposure. In High Dose Rate (HDR) brachytherapy treatment, quality assurance measures such as source calibration, dose distribution verification, and shielding requirements are crucial for accurate, safe, and effective treatment delivery. The study was conducted at Bangabandhu Sheikh Mujib Medical University (BSMMU) using a microSelectron afterloader to commissioning and decommissioning the HDR brachytherapy system, calibrates the source using well-type ionization chambers, and verifies the dose distribution of the treatment planning system using both the TG-43 and revised TG-43 formula. The shielding requirements for the HDR brachytherapy treatment were also verified to ensure the safety of the surrounding environment. The study found that the quality control measures related to critical components were satisfactory, but there was an error of 4.76% in the source calibration process due to a faulty calibration factor of the well-type ionization chamber. The dose distribution was verified for 24 dwell positions and 27.7 sec dwell time, achieving an accuracy of up to 0.046% using the revised TG-43 formula. To comply with the shielding requirements, a minimum wall thickness of 51 cm was determined to be necessary for the brachytherapy room, while the actual wall thickness was 60 cm. The study provides important insights into the quality assurance measures that need to be taken to ensure safe and effective HDR brachytherapy treatment.

* Department of Nuclear Engineering, University of Dhaka

1.3 Dosimetric Verification of Radiotherapy Treatment Planning System for 6MV, 10MV & 15MV Photon Beams Using CIRS Thorax Phantom.

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

Dosimetric Verification of RTPPs is very important to proper dose distribution of the targeted organ of the patient. Varian Eclipse treatment planning system used a unique algorithm called Anisotropic Analytical Algorithms (AAA) provided by the vendor. The goal of the study is to verify the treatment planning system (TPS) algorithm using a homogeneous CIRS Thorax phantom. It has been done to measure the dosimetric variations of 6MV, 10MV and 15MV photon beams. According to TECDOC-1583 based on IAEA TRS-430, the imported data from commissioning were examined by CIRS Thorax Phantom (CIRS - 002LFC). The

phantom was initially scanned using a Canon-Lightning Aquilion CT-simulator, and the raw data from the gated scans was then entered into an Eclipse TPS (version 13.5) program to perform the calculation. The computed dose at a chosen site was then compared with the measurement data to ensure TPS validity. The findings demonstrate that the variation between the measured doses in different holes of the CIRS thorax phantom and the calculated doses by TPS was within the allowed limit except few points among the Max. and Min. deviations for 6MV are 3.87% and 0.05% respectively. On the other hand, Max. and Min. deviations for 10MV are 7.87% and 0.12% respectively and that for 15MV are 4.44% and 0.02% respectively. Hence, it is observed that employing the CIRS Thorax Phantom for external beam radiation, the AAA algorithm of TPS is suitable for dose computation in heterogeneous medium and is more compatible for 6MV than higher energies.

* Dept. of Medical Physics and Biomedical Engineering, Gono Bishwabidyalay, Savar

1.4 A Novel Dosimetry Approach for Computer Tomography Using Polymethyl Methacrylate Phantom

R. Khatun, S. Akter, A. N. Monika, T. A. Urme* and R. A. Juma*

The main objective of this study is to investigate the severity of the absorbed dose i.e. computed tomography dose index (CTDIvol) and dose length product (DLP) for the complete examination dose undergoing CT examination in Bangladesh and compare the results with European Commission's dose guidance levels. The specific aims of this study are: to measure radiation dose from CT practice at two hospitals, to investigate the radiation exposure in CT examination and to compare some parameters (weighted CTDI, CTDI volume, DLP) among some hospital in Bangladesh with European protocol. The CTDI what was found in the study collected from the protocol of the CT examinations were well satisfied the European Guidelines criteria. But the limitation was working only on with Natore's CT units, (Toshiba Alexion-16) CT machine. Real picture will come up if all brands are considered to measure the absorbed dose of the patient for CT examinations. One CTDIvol and DLP of this investigation exceed EG dose reference criteria. The large irradiation volume or high mAs may be responsible for that. Significant observations were included: In this examination, the variation of CTDI and DLP in different age groups and different CT models were compared with the European Guideline dose level. Presentation of kVp, mAs, CTDIw, CTDIvol, DLP & Effective Dose were given for Head Examination & Body Examination. The CT examination dose was higher for Head scan, it was 39%, in the chest it was 43%. A project is possible to carry out immediately in the country for setup a dose guidance level of CT practice in Bangladesh.

* Dept. of Medical Physics and Biomedical Engineering, Gono Bishwabidyalay, Savar

1.5 Quality Control of a CT Scanner using Quality Assurance Phantom and Comparison of Computed Tomography Dose Index Volume (CTDIvol) of the Scanner Using CTDI Phantom

S. Akter, R. Khatun, A. N. Monika, U. S. B. Kashem*

Quality Control and Dosimetry of a Computed Tomography (CT) scan is required for accurate diagnostic purposes. The purpose of this research is to determine the image quality using QA phantom and Volume Computed Tomography Dose Index (CTDIvol) of a CT scan using CTDI phantom for diagnosis of the patient. The six aspects of image quality namely contrast scale, high contrast spatial resolution, low contrast detectability, noise and uniformity, slice thickness and laser light accuracy were measured and found to be compatible with the specifications of the machine. For CTDI measurement, the data were taken in axial mode with applied voltage 120 kV and current 250 mA. The beam collimation was set as 1.25 mm. The dosage estimate for the adult body (pelvic) scan technique was 18.08 mGy in the body phantom, which was 19% differing from the dose shown on the console in high resolution chest mode. With high resolution head mode, the pediatric head scan technique produced a dose estimate of 61.04 mGy in the body phantom, deviating by 7% from the console displayed dose while the adult head scan technique produced a dose estimate of 48.11 mGy in the body phantom, deviating by 15.62% from the console displayed dose. The CT scanner successfully passed the Quality Assurance test for consistent image quality and the CTDIvol has to be within a tolerance limit of $\pm 20\%$ of the reference value as per FDA and IEC recommendations. The results of this study i.e. dose estimations for Head, Pediatric Head and Body Phantom were found to be within the above range.

* Department of Nuclear Engineering, University of Dhaka

2. Seminar/ Symposium/ Conference/ Workshop/Meeting Attended:

Name of the participant	Title of the event	Organizer	Date	Place
Dr. R. Khatun	Modern Quality Assurance in Modern Radiotherapy	SCMPCR	15-18 February 2023	LABAID Cancer Hospital
	National Conference on Sylhet Cancer Congress- 2023	SCSG	05 May 2023	Grand Sylhet Hotel and Resort, Sylhet
	Nuclear Fest & Research Fair- 2023	DU	16 May 2023	DU
	Bangladesh International Cancer Congress- 2022	Oncology Club	17-18 November 2022	Army Golf Club Dhaka
	Application of Radiation in Medicine	SSDL, INST, AERE	31 May-01 June 2023	SSDL, INST, AERE, Savar, Dhaka
S. Akter	1 st International Dhaka Science Conference for Woman: WSTC-2023	WSTC	15 to 16 February 2023	Hotel Pan Pacific Sonargaon, Dhaka.
	Nuclear Fest & Research Fair- 2023	DU	16 May 2023	DU
	International Conference on Electronics and Informatics- 2022	BEIS	26 to 28 January 2023	AECD
	Bangladesh International Cancer Congress- 2022	Oncology Club	17 to 18 November 2022	Army Golf Club Dhaka
A. N. Monika	Bangladesh International Cancer Congress- 2022	Oncology Club	17 to 18 November 2022	Army Golf Club Dhaka

3. Stakeholder Meeting

Exchange of view Seminar with the STAKEHOLDERS on “Clinical Commissioning of Radiotherapy Treatment Planning System using Thorax Phantom”, 23 February, 2023, Auditorium, Atomic Energy Centre, Dhaka, Participant-72.

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

Medical Physics Division gives up the necessary support of Annual Development Project (ADP) of the Ministry of Science of Technology (MOST) entitled as the “Establishment of PET/CT & Cyclotron facility at INMAS Mymensingh and Chattogram and Cyclotron facility at Institute of Nuclear Medical Physics (INMP), Savar”, BAEC.

5. Others

Lecture delivered on FTC training course on “Nuclear and Radiological Emergency Preparedness Course at BAEC (NREPCB-11)-2022.

Non-Destructive Testing Division, AECD**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.

Program(s)

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

Activities

1. Research and Development Work(s)

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, K. Alam and R. Pritom

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 detailed 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, Sugar Mill, Fertilizer Factory, BITAC etc.

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, K. Alam and R. Pritom

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, K. Alam and R. Pritom

Eddy Current Testing Method has been using as a quality control tool for the inspection of numerous engineering components particularly the ferromagnetic 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.

A 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, K. Alam and R. Pritom

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. N. N. Alam, M. A. Habib, S. C. Dey, K. Alam and R. Pritom

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.

Several data taken from available concrete blocks using direct method are being analyzed in order to understand the characteristics of the data with a focus to assess the quality and homogeneity of concrete.

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

M. F. H. Chowdhury, M. S. Alam, M. N. N. Alam, M. A. Habib, S. C. Dey, K. Alam and R. Pritom

Ground-penetrating radar (GPR) is a non-destructive testing technique that utilizes Radio 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.

GPR equipment for soil and concrete obtained recently from IAEA under RAS1022 project, have been installed in the laboratory of NDT Division. Familiarization and understanding of the operation of the equipment including the parameters of various functions is going on. An attempt has been taken to collect data utilizing GPR equipment to understand the behavior, nature and characteristics of the collected signal from the samples. For this purpose, samples are under preparation to analyze the GPR signals.

2. Seminar /Symposium/Conference/Workshop/Meeting Attended

Name of the participant	Title of the event	Organizer	Date	Place
Mr. Md Faruque Hossain Chowdhury	“IAEA/RCA Regional Training Course on Radiographic Testing – Digital (RT-D) Level 3 for Certification”	IAEA	25 - 29 July 2022	Bangkok, Thailand
	“IAEA/RCA Final Project Review Meeting”	IAEA	17 - 21 October 2022	Manila, Philippines
Mr. Md Saiful Alam	“IAEA/RCA Regional Training Course on Radiographic Testing – Digital (RT-D) Level 3 for Certification”	IAEA	25 - 29 July 2022	Bangkok, Thailand
Mr. Md Ahasanul Habib	“IAEA/RCA Regional Workshop on Advances In Industrial Digital Radiography (DR) & Computed Tomography”	IAEA	26 - 30 September 2022	Jakarta, Indonesia
Mr. Sanjoy Chandra Dey	“IAEA/RCA Regional Workshop on Advances In Industrial Digital Radiography (DR) & Computed Tomography”	IAEA	26 - 30 September 2022	Jakarta, Indonesia
	“IAEA/RCA Train the Trainers Course on Radiographic Testing – Digital (RT-D) Level 2”	IAEA	15 May - 01 June 2023	Kajang, Malaysia

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

3.1 IAEA Projects

NDT Division has been actively participating in all IAEA/RCA Programs 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 of Bangladesh 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:

- “Strengthening Regional Capacity in Non-Destructive Testing and Examination Using Nuclear and Related Techniques for Safer, Reliable, More Efficient and Sustainable Industries Including Civil Engineering (RCA) (RAS1022)”.
- “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 and materials from IAEA under RAS1022 project:

- Ground Penetrating Radar for Soil,
- Ground Penetrating Radar for Concrete and
- Standard Flawed Specimens for Magnetic Particle Testing & Liquid Penetrant Testing methods

3.2 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 68th and 69th 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 and Bangladesh Navy, 1 participant each from Nigerian Air force & Srilanka Air Force were present in this course. The NDT Division also conducted day long practical demonstration class for the above course. This collaboration is likely to be continued.

4. Academic Activities

4.1 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 36 students of Level – 3/Term – 2 of Department of Nuclear Science and Engineering, Military Institute of Science and Technology (MIST) from 05 – 09 February 2023 to provide application based knowledge on NDT methods as a part of their curriculum activities.

4.2 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 13 – 24 December 2022 to provide familiarization and application based knowledge on NDT methods.

5. Service Rendered

Sl.	Number of service given to the organization	Nature of service	Total number/ quantity of sample	Income (BDT)
1	Active NDT Services	• Calibration of Ultrasonic Thickness Gauge	• 01 No.	2,000/-
2	Safe Naval Architects & Marine Consultants	• Calibration of Ultrasonic Thickness Gauge	• 01 No.	2,000/-
3	BITAC, Dhaka	• Ultrasonic Testing of Journal Bearing	• 05 Nos. (3 times)	5400/-
4	Bay-Tech NDT & Engineering Services	• Calibration of Ultrasonic Thickness Gauge • Calibration of Electromagnetic Hand Yoke • Calibration of Ultrasonic Flaw Detector	• 01 No. • 01 No. • 01 No.	7,000/-
5	Marine NDT & Engineering Works	• Calibration of Ultrasonic Thickness Gauge • Calibration of Electromagnetic Hand Yoke • Calibration of Ultrasonic Flaw Detector	• 02 Nos. • 01 No. • 01 No.	9,000/-
6	Innovative Engineering Services	• Calibration of Electromagnetic Hand Yoke • Calibration of Ultrasonic Flaw Detector	• 01 No. • 01 No.	7,000/-

Sl.	Number of service given to the organization	Nature of service	Total number/ quantity of sample	Income (BDT)
		• Calibration of Ultrasonic Thickness Gauge	• 01 No.	
7	PEB Steel Alliance LTD	• Calibration of Ultrasonic Thickness Gauge • Calibration of Ultrasonic Flaw Detector	• 01 No. • 01 No.	5,000/-
8	Bangladesh Industrial X-ray	• Calibration of Ultrasonic Thickness Gauge • Calibration of Electromagnetic Hand Yoke • Calibration of Light Meter • Calibration of Hardness tester	• 04 No. • 05 Nos. • 02 No. • 02 No.	24,000/-
9	Solutions NDT & Inspection Services	• Calibration of Ultrasonic Flaw Detector	• 02 Nos.	6,000/-
10	Basundhara Steel & Engineering Ltd.	• Calibration of Ultrasonic Thickness Gauge • Calibration of Ultrasonic Flaw Detector	• 01 No. • 01 No.	5,000/-
11	Saj Engineering & Trading Company	• Magnetic Particle Testing of Gas Turbine of Northwest Power Generation Company Ltd.	• 02 man days	10,000/-
12	Marine Inspection & Solutions Ltd	• Calibration of Ultrasonic Thickness Gauge	• 01 No.	2,000/-
13	Industrial Engineering Services	• Industrial Videoscope Inspection of gas cooler tube of Khulna 225 MW Combined Cycle Power Plant, Khulna • Industrial Videoscope Inspection of fire tubes and safety valves of Boiler of Raiyan Knit Composites Ltd., Chandra, Gazipur • Industrial Videoscope Inspection of several equipment of Krisenergy Ltd. Bangura Gas Field, Cumilla • Industrial Videoscope Inspection of fire tubes and safety valves of 03 Nos. Boiler of American & Efird (Bangladesh), Islampur, Gazipur • Industrial Videoscope Inspection of fire tubes of 02 Nos. Boiler of Diganta Sweater Limited, Nawjor Kodda, Gazipur	• 01 Day • 01 Day • 01 Day • 01 Day • 01 Day	110,000/-
14	Radiant Engineering Training Services and Inspection Ltd	• Calibration of Ultrasonic Thickness Gauge • Calibration of Electromagnetic Hand Yoke • Calibration of Ultrasonic Flaw Detector	• 01 No. • 01 No. • 03 Nos.	13,000/-
15	Western Marine Services Ltd	• Calibration of Ultrasonic Flaw Detector	• 01 No.	3,000/-
16	Rifat Enterprise	• Calibration of Ultrasonic Thickness Gauge	• 02 Nos.	4,000/-
17	NDE Steel Structures Ltd	• Calibration of Ultrasonic Thickness Gauge • Calibration of Electromagnetic Hand Yoke • Calibration of Ultrasonic Flaw Detector • Calibration of Light Meter	• 01 No. • 01 No. • 01 No. • 01 No.	8,000/-
18	National Tubes Limited	• Calibration of Radiographic Film Densitometer	• 01 No.	1,000/-
19	Ideal NDT Service & Training Centre	• Calibration of Ultrasonic Flaw Detector	• 01 No.	3,000/-

Sl.	Number of service given to the organization	Nature of service	Total number/ quantity of sample	Income (BDT)
20	Bangladesh Engineering & NDT Solution Ltd.	• Calibration of Ultrasonic Flaw Detector	• 01 No.	3,000/-
21	Confidence Infrastructure Ltd.	• Calibration of Ultrasonic Flaw Detector	• 01 No.	3,000/-
22	EISB - Engineering Inspection Services of Bangladesh Limited	• Calibration of Ultrasonic Flaw Detector	• 01 No.	3,000/-
23	Q&T Industrial Inspection Company	• Calibration of Electromagnetic Hand Yoke • Calibration of Ultrasonic Flaw Detector • Calibration of Light Meter	• 02 Nos. • 01 No. • 01 No.	8,000/-
24	TUV Austria Bureau of Inspection & Certification Pvt. Ltd.	• Calibration of Electromagnetic Hand Yoke • Calibration of Ultrasonic Flaw Detector	• 02 Nos. • 02 Nos.	10,000/-
25	Universal Marine Consultants	• Calibration of Ultrasonic Thickness Gauge	• 01 No.	2,000/-
26	Strucxel Engineering Enterprise	• Ultrasonic Testing and Liquid Penetrant Testing of Journal Bearing	• 02 Nos.	2,266/-
27	Bureau Veritas (Bangladesh) Private Ltd.	• Calibration of Ultrasonic Thickness Gauge • Calibration of Ultrasonic Flaw Detector	• 02 Nos. • 01 No.	7,000/-
28	Electricity Generation Company Bangladesh Ltd.	• Ultrasonic Testing and Liquid Penetrant Testing of Journal Bearings • Industrial Videoscope Inspection of Gas Turbine of 2 x 120 MW Peaking Power Plant, Shiddirgonj, Narayanganj	• 03 times • 02 days	1,28,980/-
29	Bangladesh Coast Guard	• Ultrasonic Testing of welding joints of fuel reservoir tank at ShudurChor, Bhola	• 03 man days	10,000/-
30	SME Trade Corporation	• Liquid Penetrant Testing of inlet & outlet pipelines of cooling tower of Centre for Research Reactor(CRR), AERE, Savar	• 09 man days	19,536/-
31	12 times to Ghorasal Polash Urea Fertilizer Project (GPUFP)	• Consulting Service on NDT	• 12 man month	Received: 5,75,000/- Pending: 1,25,000/- (July 2022- June 2023)
32	4 times to Bangladesh Gas Fields Company Ltd.	• Consulting Service on NDT	• 04 man month	1,95,000/- (October 2022- January 2023)
33	MIST	• Arrangement of practical session on NDT	• 05 days	25000/-
	Total			12,18,182/-

6. Others

6.1 Inspection of the Manufacturing of LTME for the construction of Rooppur Nuclear Power Plant:

Rooppur Nuclear Power Plant (RNPP), the first nuclear power plant of Bangladesh is being constructed by the Government of the People's Republic of Bangladesh at Rooppur, Pabna in collaboration with Russian Federation. To control & maintain the quality & assure safety of nuclear power plant equipment, it is required to use NDT applications in all stages of manufacturing & installation processes for the uninterrupted operation of the Plant. Considering the demands of the RNPP project, Mr. Md. Ahasanul Habib, Principal Scientific Officer of NDT Division was deployed at Saint-Petersburg, Russia from 17 November 2022 to 15 February 2023 to attend the Inspection of the Manufacturing of LTME for RNPP.

6.2 Review of Documents for Acceptance Inspection of RCP & Incoming Inspection of Different Components of LTME and non-LTME:

Along with the NPCBL personnel, the officers of NDT Division were deputed by Bangladesh Atomic Energy Commission to assist review of the documents of RCP Spherical Housing complying the requirements of Quality Plan and finalize the Acceptance Inspection at RNPP Construction Site. Besides, experts from NDT Division together with other officials of BAEC and NPCBL participated time to time to assist the incoming inspection of LTME and non-LTME at RNPP Construction Site as per office order issued from September 2022 – till now.

6.3 Consultancy on NDT at under construction Ghorasal Polash Urea Fertilizer Project (GPUFP) of BCIC, Polash, Norshingdhi:

Ghorasal Polash Urea Fertilizer Project (GPUFP) of Bangladesh Chemical Industries Corporation (BCIC) has made a 15 months long Memorandum of Understanding (MoU) initially (which has been extended twice each of 3 months duration) with the NDT Division of Bangladesh Atomic Energy Commission to receive consulting service on NDT for the construction of the country's largest fertilizer factory having the production capacity of 2800 metric ton per day. Two experts from NDT Division were deployed on a roster basis in each month from October 2021 at GPUFP Site located at Polash, Norshingdhi. Experts were engaged to monitor the execution of NDT (RT, UT & PT) work for the assessment of the quality of welding joints of various equipment like – Waste Heat Boiler, Auxiliary Boiler, CO₂ Steeper, CO₂ Absorber, 32 Storage Tanks, High & Medium Pressure above ground and underground piping, Fire Fighting Pipelines etc.

6.4 Consultancy on NDT at Bangladesh Gas Fields Company Ltd.:

“Installation of Wellhead Compressors at Location-A of Titas Gas Field” Project of Bangladesh Gas Fields Company Ltd. has made an agreement with the NDT Division of Bangladesh Atomic Energy Commission to receive consulting service on NDT. Two experts from NDT Division, Bangladesh Atomic Energy Commission were deployed on a roster basis in each month from September 2022 to December 2022 at Titas Gas Field Site located at Birashar, Brahmanbaria to monitor the execution of NDT (RT & PT) work for the assessment of the quality of welding joints of pipelines of Compressors and Tanks.

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.

Program

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.

Activities

1. Research and Development Work(s)

1.1 Management of the 3 MV VDG Accelerator and Gamma Spectrometry System

J. Abedin, M. M. Rahman and L. Hossain

Objective: 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.

Current progress: ‘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 agricultural field, medicinal plants, vegetables, different foodstuffs, and other samples like imported & locally produced powder milk from local market. Collected samples were preserved in vacuum desiccators for the protection of further contamination. Different samples were taken under experiments separately; spectrums of 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 setup, chiller setup for water cooling circulation and gas drying subsystem are essential for accelerator operation that needs at least five manpower who are technically sound.

The students of different universities have conducted their thesis experiments for PhD, MPhil and MS degrees using ‘Gamma Spectroscopy data acquisition setup’ of VDG Accelerator laboratory.

1.2 Radionuclides Detection, Analysis and Pollution Level Assessment of Soil of Coal Mine area, Dinajpur

J. Abedin, M. M. Rahman, L. Hossain and M. R. Parvin*

Objective: Assessment of pollution level due to the accumulation of radiological substances in soil of Coal Mine area, Dinajpur and their impacts on the environment as well as on living beings.

Current progress: Soil samples were taken from different depth and locations of ‘Coal Mine’ area, Dinajpur, processed & taken under gamma experiment for the detection of radiological substances accumulated somehow. Probability of being radiological substances may be more in soil of mine area and risks of contamination to the mine workers is also more than others. The collected soil samples were 1000gm each. Each of the samples was taken under gamma experiments about 4215 seconds for data acquisition. The gamma energies emitted from the radionuclides present in samples were detected by the HPGe detector, amplified and processed by MCA unit. Data acquisition and spectrum analysis were done according to the energy lines of different radionuclides by Genie-2000 software. The detected and analyzed energy lines of different radionuclides and the results of one of the soil samples are projected here;

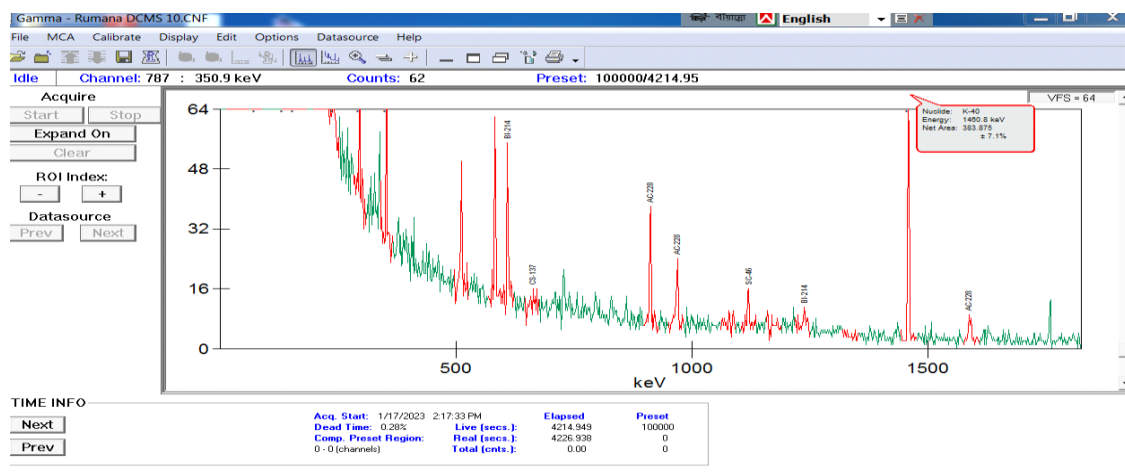


Fig: Analyzed Spectrum of one of the Soil samples (Coal Mine area, Dinajpur)

 ***** P E A K A N A L Y S I S R E P O R T *****

Filename: C:\GENIE2K\CAMFILES\Rumana DCMS 10.CNF

Sample Title : Radionuclides Detection
 Sample Size : 1000gm
 Live Time : 4214.9 seconds
 Real Time : 4226.9 seconds
 Dead Time : 0.28 %
 Date of Experiment : 1/18/2023 10:22:25 AM

Peak No.	ROI start	ROI end	ROI centroid	Peak Energy (keV)	FWHM (keV)	Net Peak Area	Net Area Uncert.	Continuum Counts
1	16-	61	21.99	9.80	1.63	1.672E+02	146.38	4.111E+03
2	16-	61	43.26	19.29	1.73	1.426E+02	124.89	2.543E+03
3	151-	200	166.74	74.35	3.42	5.575E+02	47.15	2.126E+03
4	151-	200	190.54	84.96	3.47	2.775E+02	43.13	2.342E+03
5	522-	551	534.83	238.47	1.89	8.445E+02	89.21	1.499E+03
6	650-	671	660.80	294.64	1.42	6.236E+01	56.58	8.326E+02
7	747-	799	758.19	338.06	1.56	6.761E+01	37.47	3.530E+02
8	747-	799	788.62	351.63	1.59	1.305E+02	72.02	3.145E+02
9	1135-	1159	1145.62	510.81	1.31	2.053E+02	37.68	2.938E+02
10	1296-	1378	1307.86	583.15	1.88	2.299E+02	18.20	1.162E+02
11	1296-	1378	1366.83	609.44	1.93	2.120E+02	18.29	1.184E+02
12	1621-	1644	1632.67	727.97	1.51	2.383E+01	28.60	1.982E+02
13	1849-	1943	1861.06	829.81	4.16	5.661E+01	12.97	1.271E+02
14	1849-	1943	1930.83	860.92	4.20	3.791E+01	12.32	1.556E+02
15	2032-	2057	2044.01	911.38	1.60	1.600E+02	26.99	1.340E+02
16	2161-	2186	2173.23	969.00	1.88	9.629E+01	25.29	1.277E+02
17	2501-	2526	2513.99	1120.94	2.40	6.828E+01	21.51	9.172E+01
18	3262-	3290	3276.06	1460.73	2.51	3.933E+02	24.42	4.371E+01
19	3553-	3580	3566.27	1590.13	0.49	4.621E+01	14.70	3.779E+01
20	3934-	3961	3947.16	1759.96	0.53	4.733E+01	12.20	2.167E+01

Table: Possible radionuclides and their activity concentration (Bq/Kg).

Possible nuclide	¹⁸⁷ W	²²⁷ Np	²¹² Pb	²¹⁴ Pb	²²⁸ Ac	²¹⁴ Pb	¹³³ I	²⁰⁸ Tl	²¹⁴ Bi	⁵⁴ Mn	²⁰⁸ Tl	²²⁸ Ac	⁴⁶ Sc	⁴⁰ K	¹⁵⁴ Eu	²¹⁴ Bi
Activity Con. (Bq/Kg)	25.54	11.38	32.41	6.24	13.26	4.32	30.76	5.77	16.49	2.5	13.96	25.52	34	50.68	7.51	2.22

Fig.: Comparison of activity concentration (Bq/Kg) among detected radionuclides

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

1.3 Efficiency Calibration of HPGe Detector Using the Detected Gamma Energy Lines in Danish Powder Milk

J. Abedin, M. M. Rahman, L. Hossain and M. R. Parvin*

Objective: To calibrate the efficiencies of HPGe detector for different gamma energy lines emitted from Danish powder milk sample. Detector efficiency is essential for the calculation of activity concentration.

Current progress: Different types (brands) of powder milk were collected and taken under experiments to detect the radiological contamination. The detector efficiency is an important factor that must be counted for activity calculation. For better radiological assessment, efficiency calibration of HPGe detector has been done using gamma energy values of ‘Danish’ brand powder milk and the certified efficiency data file provided with the software ‘Genie-2000’, of CANBERRA. The gamma energy lines, obtained efficiency curve and apart of calculated efficiencies have been projected below;



Figure: Detected gamma energy lines of radionuclides & their counting efficiency curve.

Table 2: Certified & calculated efficiencies of HPGe detector

Gamma energy line (keV)	Calculated efficiency	Measured efficiency (certified)	Measured error (%)	Deviation (%)
73.85	0.03385	0.03381	10.00	-0.10
85.49	0.03409	0.03417	10.00	-0.22
238.97	0.02773	0.02649	8.00	4.69
295.37	0.02408	0.02649	8.00	-9.09
350.99	0.02122	0.02036	8.00	4.24
510.98	0.01601	0.01654	8.00	-3.22
582.99	0.01455	0.01654	8.00	-12.05
609.54	0.01409	0.01260	6.00	11.85
919.19	0.01074	0.01049	6.00	2.38
967.76	0.01041	0.01049	4.00	-0.80
1121.29	0.00954	0.00910	4.00	4.78
1271.44	0.00887	0.00910	4.00	-2.48
1377.18	0.00849	0.00910	4.00	-6.72
1460.94	0.00822	0.00910	4.00	-9.71
1590.73	0.00784	0.00699	4.00	12.23
1764.57	0.00742	0.00699	4.00	6.12

Figure: Comparison curves of certified and calculated efficiencies of HPGe detector

The data table 2: shows, gamma energy lines started from 73.85 keV and ended at 1764.57 keV representing different radionuclides. The deviation (%) is less than 5% except 609.54, 1590.73 and 1764.57 keV energy lines. These efficiency values have been applied for activity calculation of different powder milk samples.

1.4 Study of Radiological Contamination of Full Cream Powder Milk their Activity Concentration by ‘Gamma Spectroscopy Setup’.

J. Abedin, M. Rahman, L. Hossain and A. Rahman*

Objective: The main objective of this research work is to assess the pollution level of ‘powder milk’ due to radiological contamination. To detect the radionuclides and their concentrations within the powder milk.

Current progress: Different types (brands) of powder milk were collected from local market and net weight of each of the packet was 1000gm. Accordingly, the packet was being set in the experiment chamber, started the gamma data acquisition, collected gamma spectrums and analyzed the data files using commercial software Genie-2000. Ten different powder milk samples were taken under experiment and the data acquisition period was 7450.30 seconds for each of the experiment. The analyzed gamma spectrums (energy lines) and the total activity concentration were calculated and data-results are shown below. These activity concentrations are with background radiation (background is not subtracted).

Table: Different (Brand) powder milk and their activity concentration

Sample ID	Brand name (full cream)	Quantity (gm)	Activity concentration (Bq/Kg)
PM02	NIDO Powder Milk	1000	1172.128
PM03	Nestle Powder Milk	1000	961.005
PM04	MARKS Powder Milk	1000	984.502
PM05	Diploma Powder Milk	1000	483.741
PM06	Danish Powder Milk	1000	2352.325
PM07	Fresh Powder Milk	1000	1545.259
PM08	Dano Powder Milk	1000	1416.853
PM09	No.1 Powder Milk	1000	859.863
PM011	AMA Powder Milk	1000	3033.346
PM012	Aarong Powder Milk	1000	2149.346

Figure: Activity comparison of different powder milk samples

According to the activity calculation of each of (1000gm packet) the 10 different powder milk samples, the highest activity concentration is in AMA brand and lowest in DIPLOMA powder milk. Comparison shows that the activity concentration of AMA>Danish>Aarong>Fresh>Dano> Nido>Marks>Nestle>No .1>Diploma.

MSc. Engineering thesis will be submitted under this program to the department of Nuclear Science & Engineering, MIST, Dhaka

* Department Nuclear Science & Engineering, MIST, Dhaka

1.5 Study of Elemental Concentration of Vegetables Samples Collected from Local Market and Assessment of Toxicity Due to Heavy Metal Contamination

J. Abedin, M. Rahman and L. Hossan

Objective: The main objective of this study is to detect elements, calculation of their concentration, and assessment their health risks due to toxicity.

Current progress: Vegetables samples were collected from local market, dried ground and made as pellets (7mm diameter & 1mm thick). The pellets were irradiated by 2.4 MeV proton beam and 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.

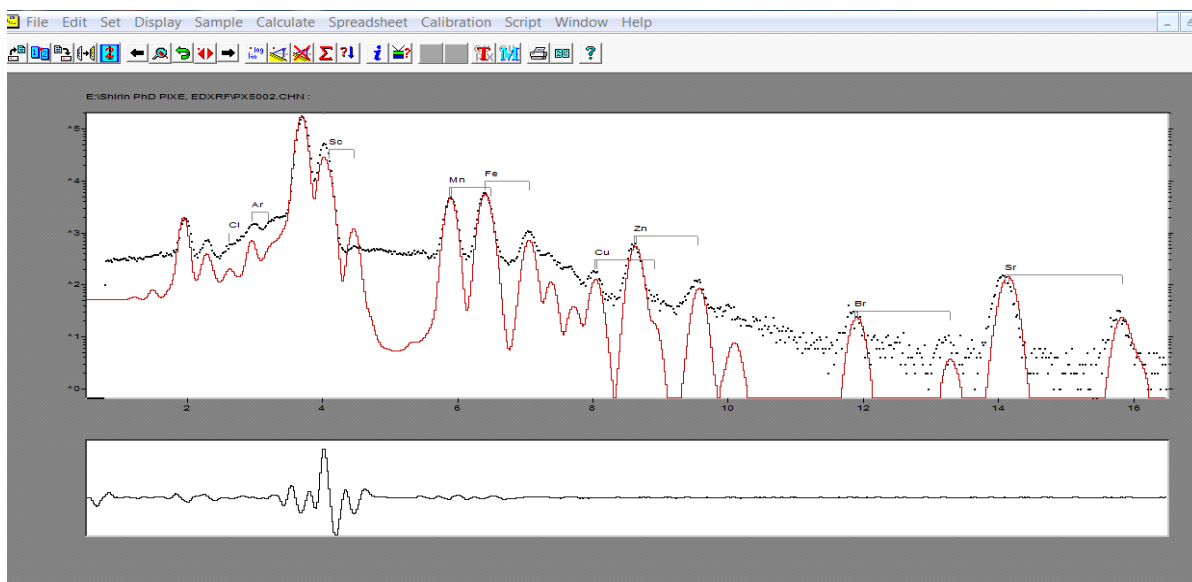


Figure: Analyzed spectrum of elements detected in a vegetable sample 'Pui-shak'

Table: Experiment data of vegetable 'Pui-shak'

Element	Concentration ($\mu\text{g/gm}$)	%Errors	LOD
Al	198.4	61.97	232.5
S	117.4	57.41	152.4
Cl	278.7	21.49	114.4
Ar	1689.1	5.27	164.1
Ca	149760.1	0.1	238.6
Sc	74885.8	4.12	5802.3
Mn	74115.2	0.62	367.3
Fe	100640.8	0.7	909
Cu	4847.1	5.54	404.5
Zn	27383.2	1.71	398
Br	4433.9	9.96	560.4
Kr	217.9	166.08	691.7
Sr	61433.7	2.79	1390.4

Figure: Graphical projection of elements & their concentration of vegetable *Pui-shak*

1.6 Radiological Assessment of Soil Pollution around 'Jaflong Waterfall Area' Sylhet

J. Abedin, L. Hossain and M.S. Islam*

Objective: The objective of this research work is to study the radiological contamination in soil surrounding 'Jaflong Waterfall Area', Sylhet.

Current progress: The soil samples were collected from different places and depth of surrounding area of 'Jaflong Waterfall Area', Sylhet. The samples were preserved in vacuum desiccators separately and kept in safe area to protect them from 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 2742 seconds. The gamma rays emitted by the radionuclides were detected by the HPGe detector. The spectrum data 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 and shown below;

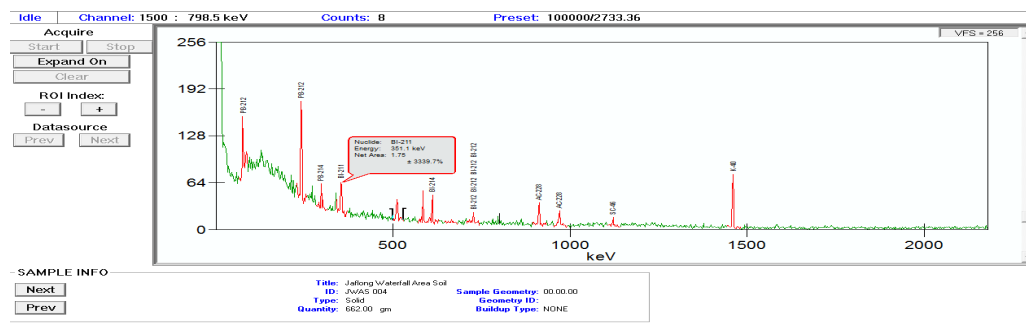


Figure: Analyzed spectrum of a soil sample collected from 'Jaflong Waterfall Area', Sylhet

Table: Analyzed data of soil of 'Jaflong Waterfall Area', Sylhet

Activity Calculation, Sample ID-JWAS-004								
Peak no.	Energy (keV)	Intensity	Net peak area	Net area uncert.	Real net area	Counting efficiency	Activity (Bq/kg)	Possible nuclide
1	74.58	0.1077	439.6	40.49	399.11	0.03423	59.8286	W-187
2	85.37	0.37	119.8	34.42	85.38	0.03456	3.68994	Xe-133
3	238.29	0.446	561.5	72.02	489.48	0.02712	22.364	Pb-212
4	295.03	0.197	111.6	58.50	53.1	0.02264	6.57947	Pb-214
5	338.02	0.02074	59.6	17.62	41.98	0.02106	53.1146	Ac-228
6	351.60	0.01924	120.0	19.56	100.04	0.01924	149.349	Pb-214
7	510.95	0.0184	161.5	31.32	130.18	0.0154	43.6595	I-133
8	583.19	0.8577	183.3	17.78	165.52	0.015	7.10989	Ti-208
9	609.29	0.433	180.6	16.08	164.52	0.01309	16.0409	Bi-214
10	727.61	0.0756	36.99	26.34	10.65	0.01203	6.47144	Bi-214
11	911.51	0.277	154.5	24.39	130.11	0.01	25.9579	Ac-228
12	968.76	0.166	97.54	23.33	74.21	0.00987	25.0309	Ac-228
13	1120.42	0.157	27.61	22.01	5.6	0.00924	2.13332	Bi-214
14	1460.90	0.107	229.0	25.34	203.36	0.00823	127.621	K-40
15	1590.34	0.0167	26.7	12.02	14.7	0.008	60.8065	Eu-154
16	1760.58	0.02	16.61	13.80	2.81	0.00774	10.0317	Bi-214
(JWAS004) Total Activity							619.788	

Figure: Graphical projection of radionuclides & their activity concentration (Bq/kg)

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). The division is started to work in January 2016 to promote fundamental, advanced and applied research works in the related areas of Fusion and plasma science. The major objective of the plasma physics division is to build up critical number of competent manpower through theoretical, computational and experimental studies.

Activities

1. Research and Development Work(s)

1.1 Design and Development of an Efficient DPF Device

M. K. Islam, M. A. Malek, M. R. Haque,

Current progress: A dense plasma focus (DPF) 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. Fusion neutron and soft X-ray productions from DPF are studied.

Study on the Fusion Neutron and Soft X-ray Productions: From the numerical experiment, a basic understanding has been acquired about the working principle and neutron and soft X-ray productions of DPG. Correlation of neutron and soft X-ray yields with plasma focus properties—like pinch current, peak current, maximum induced voltage, axial speed, radial piston speed, shock speed, plasma ion density, pinch duration are understood as a function of pressure. It has been observed that the production of fusion neutron maximizes in the pressure where pinch current maximizes. It is also observed that pinch length is constant with respect to pressure; pinch radius increases with pressure; Plasma temperature, axial and radial speed of plasma sheath increase with the decrease of pressure; plasma ion density and pinch duration increases with pressure. It is found that our computed values of neon soft X-ray yield is improved around six times from previously computed value for optimum anode configuration of the UNU/ICTP DPF machine.

1.2 Study on the Excitation and Instabilities of Dust Modes in Irradiated Dusty Plasma

M. K. Islam, M. S. Munir, A. Hossain

Objective: The effect of the photo electron on the dust modes in the irradiated laboratory and natural dusty plasmas including the effects of magnetic field is important to understand the plasma behavior more clearly in the laboratory and natural plasma environments.

Current progress: A theoretical investigation of the photoelectric effect on the low frequency dust acoustic (DA), dust ion acoustic (DIA) and ultralow frequency dust lower hybrid (DLH) modes has been done using fluid model considering collisional effects between charged and neutral particles of plasmas, lighter particles streaming along the external electric field including dust charge fluctuation. The growth rate of the instability of the modes increases with respect to photoelectric current, dust surface potential and streaming velocity of the electrons. Due to the slower streaming velocity of the ions, ions have no significant contribution to the instability of the dust modes. It is also observed that the dust modes become unstable significantly due to photoelectric effect compared to the streaming and collisional effects.

2. Seminar/Symposium/Conference/Workshop Attended

Name of the persons	Title of the event	Organizer	Date	Place
Dr. Md. Khairul Islam	National Conference on Physics-2023,	Bangladesh Physical Society	9-11 March 2023	Jahangirnagar University, Savar, Dhaka

3. Training Course Organized and Seminar Arranged

Sl. No.	Title (training program/workshop/seminar/symposium/conference)	Date	Place	No. of participant
01.	Industrial Training Sheikh Nafis Haider Department of Nuclear Engineering, Dhaka University, Dhaka	13 -24 November 2022	PPD, AECD, Dhaka	01
02.	Industrial Training Tahia Tasnim Department of Nuclear Engineering, Dhaka University, Dhaka	13 -24 November 2022	PPD, AECD, Dhaka	01
03.	Industrial Training Ehsan Sadi Khan Department of Nuclear Engineering, Dhaka University, Dhaka	13 -24 November, 2022	PPD, AECD, Dhaka	01

4. Collaboration Work

Providing support to establish Fusion Laboratory in Khulna University under the collaboration work entitled, “Establishing Dense Plasma Focus Device in Khulna University.” Ref.: 37.20.0000.004.033.020.2022 (Part-4)-596, Bangladesh Bureau of Educational Information and Statistics (BANBEIS).

The division is involved with the collaborative research work on the matters of common interest of the plasma physics group of different national and international universities. The division has close cooperation with

teachers and research students (M.Sc., M.Phil. and Ph.D.) of various universities concerning academic works. Areas of collaboration during the reporting period are given below:

Working in syllabus committee as an expert: 1) Rajshahi University, 2) Pabna University of Science and Technology, 3) Bangabandhu Sheikh Mujibur Rahman Science & Technology University, Gopalganj.

Working as an examiner (To prepare question paper and checking of answer sheets), Dept. of Nuclear Engineering, University of Dhaka.

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 "BAEC TRIGA Research Reactor (BTRR)". The BTRR is a valuable installation for various research activities in the field of Nuclear Science & Technology and it acts as a neutron source. It has a maximum steady state thermal power of 3 MW. The reactor achieved its first criticality on 14 September 1986. The reactor has so far been used in various fields of research and utilization such as, manpower development for nuclear power program in the country, Neutron Activation Analysis (NAA), Neutron Radiography (NR), Neutron Scattering (NS), experimental reactor safety research, education, training etc. Center for Research reactor (CRR) is responsible for the operation and maintenance of the reactor and its associated equipment and systems with ensuring appropriate level of safety as delineated in the Safety Analysis Report (SAR). CRR is also responsible for the preparation of various Safeguards and Additional Protocol related reports for AERE facilities on routine basis as per the agreement with the IAEA. These reports are sent to Bangladesh Atomic Energy Regulatory Authority (BAERA) through Chairman of BAEC. Finally, BAERA sends the reports to the IAEA.

Activities

1. Research and Development 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 29.81 hr and total burn up of the reactor fuel was about 8.35 MWh. A total number of 377 samples were irradiated through 11 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 this reporting period, 38 (Thirty eight) students from Military Institute of Science and Technology (MIST), 2 (Two) students from Nobojibon Polytechnic Institute, Satkhira and 134 (One hundred thirty four) students from Islamic University of Technology (IUT), Gazipur received their industrial training on reactor operation at CRR.

2. Repair, Maintenance and Renovation work(s)

Some of the non-routine maintenance works performed during the reporting period is listed below in chronological order:

July-22	• Troubleshooting and maintenance of variable frequency driver (VFD). • Installation of fire detection and suppression system. • Renovation and strengthening safety of existing 5-Ton capacity overhead crane of Reactor Building based on detailed engineering inspection by the experts. • 1250 kVA Sub-Station shut down and cleaning work completed.
August-22	• Maintenance of new Radiation Monitoring Equipment (ARM). • Troubleshooting of log power monitoring signal from the detector. • Repair & Maintenance work of Air-tight Door Control System, Central Air Conditioning System, Air Compressor, VFD including DM Plant Accessories. • Ventilation System Exhaust Fan Motor Rewinding.
September-22	• Maintenance of new stack monitor and continuous air monitoring system. • Installation of New Differential pressure transmitter (DPT). • Interfacing of TPC and new DPT. • Maintenance and Up-gradation work of Online Purification System, DM Plant and Emergency Core Cooling System (ECCS) of BTRR. • New Replacement work of Argon Fan Motor.
October-22	• Calibration of RTD modules of Thermal Power Calculator. • Repair and Maintenance of Ventilation system. • 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. • Installation work of New On line Solar System (1st Floor).
November-22	• Routine functionality check of all instruments of digital control console of BAEC TRIGA research reactor (BTRR). • Troubleshooting and maintenance of variable frequency driver (VFD). • 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. • Installation work of Magnetic conductor RIPD outgoing power supply line.
December-22	• Troubleshooting and maintenance of digital control console of BAEC TRIGA research reactor (BTRR). • Routine health checkup and functionality check of Digital Console Software (TRIGA Application) • Annual maintenance and surveillance activities were performed. • ECCS Battery rack Installed.

3. Manpower Development

(Training Program/Workshop/Seminar/Symposium/Conference Arranged)

Sl. No.	Title of (training/workshop/seminar/conference) arranged	Date	Place	No. of participants
1.	Fire Alarm System of BTRR Facility	24 July, 2022	CRR	20
2.	Fire Suppression System of BTRR Facility	24 July, 2022	CRR	19
3.	Lecture on Upgradation and Modification of On-line Purification System of BTRR	23 August, 2022	CRR	15
4.	Emergency Response Plan and Practical Demonstration on Emergency Evacuation	20 September, 2022	CRR	10
5.	Emergency Response Plan and Practical Demonstration on Emergency Fire Response	20 September, 2022	CRR	10

Sl. No.	Title of (training/workshop/seminar/conference) arranged	Date	Place	No. of participants
6.	Radiation Safety Course-1	16 October, 2022	CRR	13
7.	Radiation Safety Course-2	19 October, 2022	CRR	13
8.	Preparedness and Response for a Nuclear or Radiological Emergency	10 November, 2022	CRR	17
9.	Operational Intervention Levels (OILs) for Reactor Emergencies	17 November, 2022	CRR	12
10.	Emergency Response Plan and Practical Demonstration on Emergency Evacuation	13 December, 2022	CRR	16
11.	Emergency Response Plan and Practical Demonstration on Emergency Fire Response	13 December, 2022	CRR	16
12.	After Fukushima Accident Measures Taken for NPP and Research Reactor in Japan	22 February, 2023	CRR	14
13.	Safety Culture for Japan after Fukushima Accident	22 February, 2023	CRR	14
14.	Emergency Response Plan and Practical Demonstration on Emergency Evacuation	15 March, 2023	CRR	15
15.	Emergency Response Plan and Practical Demonstration on Emergency Fire Response	15 March, 2023	CRR	15
16.	Reactor Protection System (RPS) for BTRR	18 April, 2023	CRR	16
17.	Performance and design of data acquisition system for BTRR	18 April, 2023	CRR	16
18.	Time-dependent Neutronics Analysis using Deterministic Code	08 May, 2023	CRR	21
19.	Emergency Response Plan and Practical Demonstration on Emergency Evacuation	07 June, 2023	CRR	11
20.	Emergency Response Plan and Practical Demonstration on Emergency Fire Response	07 June, 2023	CRR	11

4. Stakeholder Meeting:

- Stakeholder Meeting with scientists from RNPd, HPRWMU, RPED and NRCD of INST.
- Stakeholder Meeting with scientists from RNPd, HPRWMU and NRCD of INST.

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

ADP Project (Ongoing): 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.

INSTITUTE OF NUCLEAR SCIENCE AND TECHNOLOGY (INST), AERE

Radioisotope Production Division, INST

Objective

The major objective of the Radioisotope Production Division (RIPD) of the Bangladesh Atomic Energy Commission (BAEC) is to attain self-reliance in the production of radioisotopes and radiopharmaceuticals for

medical purposes. $\text{Na}^{99\text{m}}\text{TcO}_4$ (i.v. administration) and Na^{131}I solution (oral administration) are extensively utilized in the nuclear medicine centers of BAEC and other private as well as public hospitals across the country. Indigenous production of $^{99}\text{Mo}/^{99\text{m}}\text{Tc}$ generator at RIPD has substituted overseas import. This achievement ensures a stable and consistent supply of these radioisotopes for medical applications in Bangladesh. To support the production of radiopharmaceuticals, the RIPD has established an ISO-certified clean room facility. This facility is capable of producing $^{99\text{m}}\text{Tc}$ cold kits, such as MDP, DPTA, and DMSA, which are used in specific diagnostic procedures. The RIPD is in the process of obtaining drug licenses and certifications, which are necessary for the production of radiopharmaceuticals. Overall, the RIPD's efforts in radioisotope production and research & development activities are contributing to the advancement of nuclear medicine in the healthcare of 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. Research and Development Work(s)

- Effect of Radioactive Concentration of $\text{Na}_2^{99}\text{MoO}_4$ on Chromatographic $^{99}\text{Mo}/^{99\text{m}}\text{Tc}$ Generator.
- Comparative Study of Different Radionuclides in The Imported Fission Produced ^{99}Mo Solution at Radioisotope Production Division
- R&D Work on $^{99\text{m}}\text{Tc}$ Radiopharmaceuticals 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

Title	Date	Place	No of participant
Conducted full theoretical and practical courses of MD Residency (Nuclear Medicine) course of BSMMU	September 2022-February 2023	INST, AERE	07
Industrial training program for the partial fulfillment of the requirement for the B.Sc. (Honours) Degree of the students of Jahangirnagar University, Savar, Dhaka	25 July – 25 August 2022	RIPD, INST	04
Conducted two weeks training program for the students of the Department of Nuclear Engineering, Dhaka University.	13-24 November 2022	RIPD, INST	02

5. Seminar/Symposium/Conference/Workshop/Scientific Visit/Meeting Attended

Name of the participant	Title of the event	Organizer	Date	Place
Dr. M. F. Waheed	Regional Training Course on Regulatory Aspects of Radiopharmaceuticals Production with GMP Requirements.	IAEA	18 – 22 July 2022	Ulaanbaatar, Mongolia

Name of the participant	Title of the event	Organizer	Date	Place
Dr. Rabeya Akhter, R. Amin	International Conclave on Material, Energy and Climate-2022.	ACCE, University of Dhaka.	19-20 December 2022	Nabab Nawab Ali Chowdhury Senate Bhaban, University of Dhaka.
R. Amin, K. K. Hossain	Environmental Radioactivity Monitoring Course at BAEC (ERMC-10)-2023.	Training Institute, AERE	15 - 19 January 2023	Training Institute, AERE
R. Amin	Seminar on Chronicles of Reactor Based Medical Radioisotope Production in Bangladesh: Contribution in last 25 years.	INST, AERE	01 February 2023	Conference Room, INST, AERE
R. Amin	Reactor Engineering Course at BAEC (RECB-10)-2023.	Training Institute, AERE	12 February – 02 March 2023	Training Institute, AERE
M. A. Shabuj, M. T. Aziz	National Conference on Physics-2023	BPS	9 – 11 March 2023	JU, Savar, Dhaka.
Dr. F. T. Jahura	Seminar-Workshop on Basics of Radiation Protection and Radiotherapy Dosimetry.	SSDL, HPRWMU, INST, AERE	21 – 22 March 2023	SSDL, HPRWMU, INST, AERE
Dr. M. F. Waheed, Dr. R. Akhter	International Symposium on Trends in Radiopharmaceuticals.	IAEA	17 – 21 April 2023	Vienna, Austria

6. Collaboration Work(s)

IAEA TC Project BGD/6/022: “Producing Therapeutic Radiopharmaceuticals”.

Objective: 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. Lecture Delivered

Scientists of this division conducted both theoretical and practical courses in the MD Residency (Nuclear Medicine) course of BSMMU.

8. Service Rendered and Revenue Income

Number of services given to organization		Nature of service	Total number/ amount (GBq)	Income (BDT) (ref: monthly report)
Under BAEC	Others			
NINMAS and 14 INMASs	Government Hospitals: NICVD, Dhaka & CMH, Dhaka Non-Government. Hospitals: LabAid, Dhaka; Evercare Hospital Dhaka; United Hospital Dhaka; & Ahsania Mission Hospital, Dhaka.	Supply of $^{99}\text{Mo}/^{99\text{m}}\text{Tc}$ generator	1066 nos. of $^{99}\text{Mo}/^{99\text{m}}\text{Tc}$ generators	13,99,21,000/-
NINMAS and 14 INMASs	CMH, Dhaka	Supply of ^{131}I radioisotope	3986.94 GBq of ^{131}I Oral Solution	3,89,71,000/-
Total				17,88,92,000/-

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.

Activities**1. Research and Development Work(s)****1.1. Adsorption of Methylene Blue on γ -Radiation-Assisted Starch/Acrylic Acid/4-Styrenesulfonic Acid Sodium Salt hydrogel and Investigation of the of Adsorption Parameters**

T.Ahmed, M. S. Rahaman, S. M. M. Hasnine, S. Sultana, M. J. Alam, M. M. Rahman, F. Khatun and Z. Hasan

Starch/acrylic acid/4-styrene sulfonic acid sodium salt hydrogel was prepared using gamma radiation at 15 kGy, the composition of which were optimized to be 5: 25: 10 for suitable network parameters. Methylene Blue as a model cationic dye was absorbed into the hydrogel network and the kinetics, isotherm, and mechanism has been discussed in this work. The dye adsorbed following a pseudo second order kinetics where the hydrogel accepted the dyes following mostly Langmuir model of isotherm where film diffusion was the rate limiting factor in the intraparticle diffusion system.

1.2. Preparation and Characterization of γ -radiation-Assisted Starch/Acrylic Acid/4-Styrenesulfonic Acid Sodium Salt Hydrogel and Optimization of the Network Parameters

T. Ahmed, M. S. Rahaman, S. M. M. Hasnine, S. Sultana, M. J. Alam, M. M. Rahman, F. Khatun and Z. Hasan

Starch/Acrylic acid (AAc)/4-Styrenesulfonic Acid Sodium Salt (SSS) based hydrogels were prepared by using simple and facile Gamma radiation (Cobalt-60 source) technique. The prepared hydrogels were characterized by Fourier Transform Infrared-Attenuated Total Reflection (FTIR-ATR), Scanning Electron Microscopy (SEM), and Thermogravimetric Analysis (TGA). The influences of different parameters such as radiation dose, constituents of hydrogels, pH, ionic strength on different hydrogel properties like crosslinking density (CD), porosity, gel content, and swelling behavior were investigated in detail. Results showed that porous hydrogels were formed with well-interconnected networks. The maximum gel fraction 97.95% was observed for 15% starch concentration and the high-water penetration in the hydrogel with a high swelling ratio (3072%) was found at 25% AAc in the hydrogel composition.

1.3. Investigation of Adsorption Mechanism of Poly-Vinyl Alcohol/Acrylic Acid/Poly-4-Styrene Sulphonic Acid-Based Hydrogel Prepared by Gamma Radiation

S. M. M. Hasnine, T. Ahmed, M. S. Rahaman, S. Sultana, M. J. Alam, M. M. Rahman, F. Khatun and M. A. R. Azady

In this work, the hydrogel was synthesized by copolymerizing polyvinyl alcohol (PVA), acrylic acid (AAc), and poly-4-styrene sulphonic acid (PSSa) using gamma irradiation. The radiation dosage range used in this study was 10–30 kGy. During the analysis, it was determined that since the Weber and Morris fitting line did not pass through the origin, there must be other limiting variables affecting the whole adsorption process in addition to intraparticle diffusion. The Weber and Morris plot's lower value for boundary layer thickness ($C=1.4646$) revealed that the influence of the boundary layer on the adsorption process was minor. It was evident from the Boyd kinetic plot that it was linear but did not pass through the origin, indicating that the adsorption process was regulated by film (external diffusion) although intra particle diffusion was also play a vital role for the adsorption of Methylene Blue (MB) onto the PVA/AAc/PSSa based hydrogel.

1.4. Investigation of Thermodynamics and Reusability Study of Gamma Radiation Assisted PolyVinyl Alcohol/Acrylic Acid/Poly-4-Styrene Sulphonic Acid Based Hydrogel.

S. M. M. Hasnine, T. Ahmed, M. S. Rahaman, S. Sultana, M. J. Alam, M. M. Rahman, F. Khatun and M. A. R. Azady

In this study, poly-vinyl alcohol (PVA), acrylic acid (AAc), and poly-4-styrene sulphonic acid (PSSa) were copolymerized in different compositions using gamma irradiation to form the hydrogel. From the thermodynamics study it was found that the negative values of ΔH ($-18.57 \text{ kJmol}^{-1}$), confirmed that the adsorption process was exothermic and more favorable at lower temperature. The reusability study specified that the sorption capacity gets reduced from 91 to 57.50% after four consecutive cycles ensuring that the hydrogel can be effectively utilized as recyclable adsorbents for industrial applications.

1.5. Application of Amine Functionalized Glycidyl Methacrylate Grafted Non-Woven Polyethylene Fabric in the Removal of Cr (VI) Ion from Aqueous Solution

N. Rahman, S. Shahnaz, M. N. Sardar, A. R. Miah, M. H. Kabir

Radiation induced grafting technique was applied to graft glycidyl methacrylate (GMA) on non-woven polyethylene (PE) films and amine functionalized GMA-g-non woven PE films were prepared through chemical treatment with triethylamine. Amine functionalized GMA-g- non woven PE films were treated with HCl to enhance its adsorption capacity and utilized for the adsorption of Cr (VI) ions from aqueous solution. Adsorption capacity was investigated through varying the adsorption parameters. The optimal circumstance that can lead highest adsorption of Cr(VI) by the adsorbent was established to be contact time 24 hours and initial metal concentration 600 mg/L, pH 1.2 and temperature 75°C. Langmuir and Freundlich isotherm model were used for the metal adsorption process to understand the adsorption mechanism. The adsorption of Cr (VI) ion was successfully inferred with pseudo-second-order model. Desorption and reuses of the adsorbent film were also investigated suggesting the possibility of recycling of the adsorbent.

1.6. Adsorption of Aqueous Cationic Dyes Using Waste Plastic Bag Followed by Pre-irradiation Grafting Method

M. N. Sardar, N. Rahman, S. Shahnaz, A. R. Miah, M. H. Kabir

In the past few years, waste plastic and industrial effluent have both become major environmental problems. The goal of this study was to find out how well radiation-grafted plastic waste (polypropylene fabric) works as an adsorbent to remove the toxic industrial dyes methylene blue (MB), basic fuchsin (BF), and crystal violet (CV) from water solutions. The graft polymer was produced through the reaction of pre-irradiated waste polypropylene (PP) fabric with a monomer solution made up of acrylic acid and sodium styrene sulfonate. The percentage of grafting was 390 % at 30 kGy gamma radiation. FTIR and SEM analyses were performed on the pristine polypropylene fabric as well as on the grafted adsorbent. In the adsorption investigation, parameters like the initial dye concentration, pH, the time the dyes were in contact with the adsorbent surface, and the temperature were looked at to see how they affected the adsorption process. After the kinetic data were fit to a pseudo-second-order kinetic model, the observed and calculated sorption capacities were found to be more in line with each other. The equilibrium data might be appropriately interpreted using the Langmuir adsorption isotherm with the highest regression coefficient value. The maximum sorption capacities were calculated from the Langmuir isotherm and were 270.27, 95.24, and 454.55 mg per gram of the adsorbent for MB, BF, and CV, respectively. Thermodynamic measurements show that adsorption is spontaneous, endothermic, and feasible. A desorption analysis of the dyes reveals that the adsorbent is a better candidate for removing cationic dyes.

1.7. Physicochemical Analysis of Few Locations of the Daleshwari River & Their Adjacent Drinking Water in Bangladesh

M. Mahfujur Rahman, M. Ferdous Alam, M. A. Ali, K. Akter, R. Hasan, M. A. Hanif, S. Akter, M. Shalauddin and Salma Sultana

The present study has been conducted at the four locations of the Dhaleshwari River (DR) and their adjacent point's drinking water (DW) samples to analyze the physico-chemical parameters and quality assessments. The physical parameters of DR-water and their adjacent DW-water samples were pH (7.03-7.16), EC (871.8-913.2 $\mu\text{S/cm}$), TDS (486.2-502.4 ppm), Salinity (0.37-0.4 ppt), Resistivity (1.09-1.15 K Ωcm), Temperature (25.7-26.3°C) and pH (6.53-7.09), EC (296.4-480 $\mu\text{S/cm}$), TDS (163-264 ppm), Salinity (0.07-0.16 ppt),

Resistivity (2.08-3.37) and Temperature (26.2-26.6°C) respectively. The chemical analyses of the samples were exhibited as TA (354.67-381.33mg/L), TH (377.33-392mg/L), Cl^- (45.32-52.65mg/L), Ca^{2+} (120.67-128.67mg/L), NO_3^- (3.61-4.45mg/L), SO_4^{2-} (15.47-26.64mg/L) and SiO_2 (241.33-257.33mg/L) for DR water samples, and TA (180-209.33mg/L), TH (256-460mg/L), Cl^- (19.33-52.65mg/L), Ca^{2+} (100.67-114.67mg/L), NO_3^- (1.25-16.41mg/L), SO_4^{2-} (2.63-5.95mg/L) and SiO_2 (201.33-229.33mg/L) for DW samples. At few locations, the physico-chemical parameters have found in the limit with respect to the standard values, while they have exceeded at some locations, which can cause environmental, agricultural & industrial hazards

2. Seminar/Conference/Workshop/Meeting Attended

Name of the participant	Title of the event	Organizer	Date	Place
Dr. Salma Sultana	FNCA 2022 Workshop on Radiation Processing and Polymer Modification for Agricultural, Environmental and Medical Applications	FNCA	28 November-02 December, 2022,	QST, Takasaki, Japan
	1st International Dhaka Science Conference for Women - WSTC 2023,	BAEC and Uppsala University, Sweden	15-16 February, 2023	Hotel Pan Pacific Sonargaon, Dhaka,
	National Conference on Physics-2023	BPS	09-11 March 2023	Jahangirnagar University, Savar, Dhaka,
Md. Mahfuzur Rahman	AITC-2022 Training Course on “Nuclear & Radiological Emergency Preparedness”	IAEA	20-30 September, 2022	Japan
Dr. Nazia Rahman	Workshop to launch the Guideline for integrating Electron Beam Technology into Polymer Recycling	IAEA	17-21 October 2022	KAERI, Republic of Korea
	1st International Dhaka Science Conference for Women - WSTC 2023	BAEC and Uppsala University, Sweden	15-16 February, 2023,	Hotel Pan Pacific Sonargaon, Dhaka,
	National Conference on Physics-2023	BPS	09-11 March 2023	Jahangirnagar University, Savar, Dhaka,
Shahnaz Sultana	1st International Dhaka Science Conference for Women - WSTC 2023,	BAEC and Uppsala University, Sweden	15-16 February, 2023,	Hotel Pan Pacific Sonargaon, Dhaka,
	National Conference on Physics-2023	BPS	09-11 March 2023	Jahangirnagar University, Savar, Dhaka,
Md. Nabul Sardar	International Conference on Environmental Protection for Sustainable Development (ICEPSD-2022)	BCSIR	2-4, September 2022	Dhaka, Bangladesh.
	BCSIR congress	BCSIR	1-3 Dec, 2022	Dhaka, Bangladesh.
	National Conference on Physics-2023	BPS	09-11 March 2023	Jahangirnagar University, Savar, Dhaka,
Tanvir Ahmed	Development of biocompatible hydrogel from natural polymers using quantum beam technique	MEXT	September 26, 2022 to February 03, 2023	QST, Takasaki, Japan

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.

Activities

1. Research and Development Work(s)

1.1 Background Gamma Radiation Measurement in the Southwest Region of Bangladesh: A Part of Countrywide Background Radiation Mapping

M. Ahmed, M. A. Rahman, M. A. Haydar, M. F. Uddin, S. Paul, A. Rahim, M. H. Rahman, B. C. Sutradhar, K. Asaduzzaman, M. I. Ali

Background radiation in the human environment is due to the presence of cosmogenic and primordial radionuclides (^{238}U , ^{232}Th , and ^{40}K) in the earth's crust as well as man-made (fall-out from nuclear weapon test, nuclear accidents, discharge from nuclear reactors etc.) radiation sources. As the countries' first Nuclear Power Plant (NPP) is expected to be in operation within a couple of years, hence it is rational to have an estimation of the background radiation level throughout the country before the commercial operation of the NPP. Such monitoring is very useful in assessing the possible radiological risks to public health, for the guarantee of normal commercial operation, and for fallout distribution assessment if any accident occurs. In this context, background gamma radiation dose levels were measured at the surface (5cm from the ground) level and 1m above the ground level at 68 pre-defined points in the country's 31 districts of the southwest region. At the surface level, the measured gamma radiation dose rate was varied from 0.06 to 0.17 $\mu\text{Sv/h}$, while its range was 0.06 to 0.13 $\mu\text{Sv/h}$ at 1 meter above the ground level. The highest dose 0.15 $\mu\text{Sv/h}$ was measured at Haragach, Rangpur (latitude: $25^{\circ}49'31.2''\text{N}$, longitude: 89.334702° $89^{\circ}20'4.92''\text{E}$). Further study will be carried out for Gamma spectrometry analysis of the collected surface soil and subsurface drinking water from those selected locations to make sure about the anthropogenic and natural radionuclides distributions in this region. The outcomes of this study could be the baseline database for further series of studies and regular monitoring of environmental radioactivity.

1.2 Background Gamma Radiation Mapping in the Vicinity of Rooppur Nuclear Power Plant (RNPP)

M. Ahmed, M. A. Rahman, K. Fatema, M. A. Haydar, M. F. Uddin, S. Paul, A. Rahim, M. H. Rahman, B. C. Sutradhar, K. Asaduzzaman, M. I. Ali

Routine as well as accidental release of radioactive materials from Nuclear Power Plant (NPP) may cause harmful effect to mankind and the environment. Determining the distribution of radiation doses that are present in the environment is necessary for assessing the effects of radiation exposure on public health. Before and after the operation of an NPP, it is very important to monitor the environmental radiation in its vicinity to determine any changes in radiation level with time as a result of radioactive material released from the NPP. Such monitoring is very useful in assessing the possible radiological risks to public health in the area where the nuclear power plant is installed and for the guarantee of normal commercial operation. In this regard, background gamma radiation doses were measured at the surface (ground) level and 1 meter above the ground level at 108 predefined locations around 32 km radial areas of RNPP. At the surface level, the measured gamma radiation dose rate varied from 0.06 to 0.12 $\mu\text{Sv/h}$, while almost the same dose level was observed at 1 m above the ground level. The highest dose of 0.12 $\mu\text{Sv/h}$ was measured near Nabinagar Jame Mosque, Lalpur, Natore (latitude: 24°10' 15.357" E; longitude: 88°59'16.706" E). This is the fifth survey report of background gamma radiation dose level and its distribution at the RNPP site.

1.3 Characterization and Management of Solid Radioactive Waste Stored in CWPSF, INST: A Gamma Spectrometry Approach.

M. A. Haydar and K. Asaduzzaman

Over the years, nuclear technology has gained significant importance in various fields worldwide. Bangladesh is one such country where nuclear technology has been adopted in recent times. While nuclear technology offers numerous benefits, it also produces by products (radioactive waste) that, if not managed properly, can pose a significant risk to the environment and living beings. To manage radioactive waste effectively, it is of vital importance to characterize it properly. Therefore, the primary objective of this study was to identify and quantify of the radionuclides present in solid radioactive waste samples collected from the CWPSF, INST in Savar, Dhaka by using high purity germanium detector of 40% relative efficiency. The analysis revealed that artificial radionuclides, like, ^{54}Mn , ^{60}Co , ^{137}Cs , and ^{152}Eu are present in almost all the analyzed samples. Radioactivity levels varied significantly across the samples, with sample RS_US_UN_Re_10 having the highest activity of ^{60}Co at 72297 ± 13651 Bq/kg, followed by sample RS_US_UN_Re_1 at 70612 ± 13839 Bq/kg. Sample RS_US_UN_Re_11 had a moderate activity with ^{60}Co at 57635 ± 10466 Bq/kg and low activity with ^{54}Mn at 278 ± 38 Bq/kg. Sample RS_US_UN_5 had the lowest activity among the samples. Regarding ^{152}Eu , sample RS_US_UN_Re_1 had the highest activity at 18654 ± 2873 Bq/kg. Based on the concentration levels, the characterization and classification were conducted according to IAEA safety standard GSG-1. The time required to reach clearance levels for landfill disposal of ^{60}Co , ^{152}Eu , and ^{54}Mn was also estimated and recorded for each sample. The findings of the study can provide a baseline database for future management of solid radioactive waste in Bangladesh.

1.4 A Gamma Spectrometry Approach to Managing and Characterizing Liquid Radioactive Waste Stored in CWPSF Inventory at INST

M. A. Haydar and K. Asaduzzaman

The study presents the results of the gamma ray spectroscopic analysis of artificial radionuclides in 14 liquid radioactive waste samples resourced from CWPSF, INST at AERE, Savar, Dhaka. The analysis was carried out by using High-Purity Germanium Detector (supplied by Canberra) of 20% relative efficiency. Artificial radionuclides, like, ^{60}Co , ^{125}Sb , ^{133}Ba , ^{134}Cs , ^{137}Cs , and ^{152}Eu were found in almost all the analyzed samples. The study shows that the most significant nuclides present in the samples were ^{137}Cs , ^{60}Co , and ^{152}Eu . The radionuclide ^{137}Cs was detected in all the samples and its activity levels found to be varied from 4 ± 1 Bq/kg to 85522 ± 4647 Bq/kg. The activity concentration of ^{60}Co was observed in the range of 52 ± 4 Bq/kg to 2882 ± 194 Bq/kg and the same for ^{152}Eu was 14 ± 4 Bq/kg to 1617 ± 433 Bq/kg. Meanwhile, the activity concentrations of low active radionuclides, e.g., ^{133}Ba , ^{125}Sb , and ^{134}Cs were quantified as 22 ± 7 Bq/kg to 511 ± 55 Bq/kg, 8 ± 4 Bq/kg to 129 ± 32 Bq/kg and 5 ± 1 Bq/kg and 33 ± 5 Bq/kg, respectively. Based on the activity concentration and referring to IAEA General Safety Guide, No. GSG-1, it can be concluded that all the analyzed liquid

radioactive waste samples are low and intermediate level. This study has provided valuable insights into the physio-chemical properties of liquid radioactive waste, including its radioactivity, and stability. The outcomes refer to the possible characterization process and discuss the effectiveness of waste treatment and disposal processes. Overall, this research contributes to the growing body of knowledge on the characterization of liquid radioactive waste and its safe management.

1.5 Collapsed Photonic Crystal Fibre Thermoluminescence Dosimetry for External Beam Radiotherapy

M. Begum, H. I. Almohammad, A.K. M. Mizanur Rahman, H.A. Abdul-Rashid, Z. Yusoff, Z. Y. Hamd, M.U. Khandaker and D.A. Bradley

Thermoluminescence dosimetry (TLD) is one of the more favored means of conducting ionizing radiation dosimetry, convenient for instance in terms of reusability and cost-effectiveness, and also offers a typically large detection range. In measuring exposure to ionizing radiation various detectors and techniques have been developed. Current investigation is of key TL dosimetric responses of Ge-doped collapsed photonic crystal fibre (PCF), a form offering the advantage of greater sensitivity compared to more conventional single-mode optical fibers. The PCF samples that have been studied herein have been used to obtain external photon beam percentage depth doses (PDD), elevated sensitivity being desirable in providing a basis for the capture of the range of doses. Using a linac operated at 6 and 10 MV, the results show a favorable comparison with ionization chamber values (typically to within 5%). In 6- and 10 MV photon beam applications the sample responses are seen to show negligible dependence on beam energy. Threshold doses of 28- and 27 mGy were found for 6 and 10 MV photon beams respectively. The sample also offered reproducibility to within 3%, measured for 4 Gy irradiations. The findings of the study are expected to be useful in developing sensitive high-resolution silica optical fibre TL media in ionizing radiation dosimetry.

1.6. Measurement of Natural Radioactivity Levels in Soil, Sediment, and Water Samples Collected from the Padma River around Rooppur, Bangladesh

S. Paul, M. A. Haydar and K. Fatema

A baseline study undertaken to evaluate the natural radioactivity levels in soil, sediment and water samples collected from the Padma River near the ongoing nuclear power project in Rooppur, Bangladesh using a High-Resolution Germanium detector (HPGe). Samples of three categories (soil, sediment, and water) are collected, processed and analyzed. The activity profile of radionuclides shows higher activity across the study area. The average activity concentrations of ^{226}Ra , ^{232}Th , and ^{40}K in soil samples are found to be $43.53 \pm 0.25 \text{ Bqkg}^{-1}$, $63.57 \pm 0.14 \text{ Bqkg}^{-1}$, and $690.14 \pm 1.60 \text{ Bqkg}^{-1}$, respectively, which higher than the worldwide average values. Sediment samples show the activity concentrations of ^{232}Th , and ^{40}K are $50.02 \pm 0.14 \text{ Bqkg}^{-1}$ and $502.00 \pm 1.60 \text{ Bqkg}^{-1}$, respectively. The average absorbed dose rates for soil and sediment samples are found to be 87.49 nGyh^{-1} and 67.24 nGyh^{-1} , respectively. The estimated outdoor annual effective doses for soil and sediment samples are found to be 0.11 mSv y^{-1} and 0.08 mSv y^{-1} , respectively. The values of radium equivalent activity in almost all the samples were less than 370 BqKg^{-1} . The external hazard index for soil and sediment samples varied between 0.47 to 0.53 and 0.29 to 0.59, respectively. The calculated external hazard index (Hex) are found less than unity. The values of hazard indices confirmed that all the sampling areas are safe for the human to live and work.

1.7. Shielding Assessment of The Cyclotron Facility Using Monte Carlo Simulation: Radiation Protection Perspective.

M. Ahmed

Cyclotrons are widely used to produce high yields of short half-life, neutron-deficient radioisotopes for medical and research sectors. During the normal operation of a cyclotron for producing ^{18}F radioisotopes, generated intense neutron and gamma radiation fields increase the risk of radiological hazards to radiation workers, patients, and the public. Due to the unavailability of experimental data in such cases, the computer code-based simulation is a smart choice to estimate the shielding effectiveness. This study used the Monte Carlo N-Particle radiation transport code (MCNP) to assess the shielding effectiveness of an under-construction cyclotron at the Nuclear Medical Physics Institute (NMPI), BAEC. An estimation of the neutron

and photon flux induced by 16.5 MeV protons on the water target was calculated by MCNP6.2 codes. Dose rates arising from the produced ionizing radiations are valued and found that the INMP cyclotron vault effectively shields the radiation, reduces the exposure level to the beneficiaries, and complies with recommendations from international organizations and local regulatory authorities. The outcomes of this study will be directly impactful in assembling the appropriate entrance door and maintaining the radiation safety principles during the facility operation.

1.8 Tungsten Oxide Coated Polytetrafluoroethylene-Tungsten Film for Radiation Shielding Application.

M. M. H. Bhuiyan, M. Ahmed, B. N. Sattar, M. M. Morshed, H. M. Jamil

The utilization of high-energy ionizing radiations, particularly gamma rays, is experiencing rapid expansion. The inadvertent exposure to highly energetic and penetrating gamma rays is causing significant concern due to the detrimental impact it can have on human life, the environment, and various materials. Hence, safeguarding the human population and the environment from the harmful effects of radiation is crucial, and it relies on four key factors: time, distance, shielding, and activity. Polymers exhibit great promise among the available materials owing to their mechanical, electrical, thermal, and multifunctional characteristics. By combining polymers with high atomic numbers, it becomes possible to achieve materials that are lightweight, flexible, easy to process, and ideal for gamma radiation shielding. In this research, we first collected Polytetrafluoroethylene (PTFE) powder, Tungsten Oxide, and Tungsten Metal particles from the market. Once the purity of the polymer and metals were confirmed as a high percentage through FTIR, TGA, DSC, and XRD tests, composites of PTFE and Tungsten Metal were made by mixing in various ratios: 100:0, 90:10, 80:20, 70:30, 60:40, 50:50, 40:60, 30:70, and 20:80 using a ball mill. Subsequently, radiation attenuation was tested, but the results showed very low attenuation, which was a maximum of 8%. Therefore, we decided to increase the thickness and decrease the diameter of the sample. Hence, a new disc with a diameter of 3.5mm was made, following the same procedure. This time, the results are found better than the previous attempt, with radiation attenuation reaching 50%. Further study will be carried out to develop composites that can achieve 100% radiation attenuation and withstand adverse environmental conditions.

1.9. Radiation Safety and Shielding Evaluation of Newly Installed Medical Linac Facility in Bangladesh.

M. F. Uddin, M. Begum and M. Ahmed

Medical linear accelerator (Linac) is widely used for radiotherapy purposes which is the best method for cancer treatment. Prior to the acceptance and commissioning of Linac, a preliminary survey is required in several aspects including a complete assessment of radiation shielding, and based on the detailed report the license is issued to the stakeholders. Worldwide several organizations provided various recommendations regarding shielding design and radiation safety issues. The purpose of this study is to monitor and validate the radiation protection and shielding assessment process of the newly installed Linac facility in Dhaka City, 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 show 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.

1.10. Measurement of Photo-neutron Dose in Radiotherapy for 15 MV Photon Beam from Medical LINAC

H. M. Jamil, K. M. M. Morshed and M. S. Rahman

Radiotherapy is the leading mechanism for the treatment of cancer patients in all over the world as well as in Bangladesh. High-energy linear accelerators ($>10\text{MV}$) are increasingly used in the medical field to treat cancer. Medical linear accelerators (LINACs) operating above 10 MV for high energy photon therapy produce unwanted neutrons (photo-neutron) using photonuclear reaction (γ, n) between bremsstrahlung photon beams and constituent materials of LINAC head. This study measures the neutron dose and the ambient dose

equivalent rate from a 15 MV photon beam from a medical linear accelerator (Elekta type) of Enam Medical College & Hospital, Savar, Bangladesh. The neutron dose was measured by Albedo TLDs enriched in ^6LiF & ^7LiF crystals. ^6LiF crystal is sensitive to photon and neutron radiation, and ^7LiF crystal is sensitive to only photon radiation. All TLDs were calibrated with ^{137}Cs , ^{60}Co , and $^{241}\text{Am-Be}$ source in SSDL, AERE, Savar, Bangladesh before LINAC exposures. A neutron survey meter was used to measure ambient dose equivalent. Neutron dose and the ambient dose equivalent were obtained as a function of the delivered dose, field size & detector position. In this study, two LINACs were used for the investigation purpose. The LNT model calculated second-cancer risk due to the outfield dose. The neutron dose, the ambient dose equivalent rate, and the risk of second cancer found in this work, are non-negligible and should be considered as hazardous as overdose, which may raise an excess lifetime risk for cancer induction both to the patient and the radiation worker.

1.11. Evaluation of Calibration Factors and Sensitivity Analysis of Neutron Measurement Devices for Am-Be Neutron Field

H. M. Jamil and M. S. Rahman

This study evaluated the neutron sensitivity of Thermoluminescent dosimeters and ^3He -based proportional counter through the $^{241}\text{Am-Be}$ neutron source by considering all the calibration and correction factors. The Secondary standard dosimetry laboratory (SSDL) of the Bangladesh Atomic Energy Commission has an irradiation system with radiological protection against radiation emitted by a $^{241}\text{Am-Be}$ neutron source. The source is placed inside the OB26/1 container carrying 174.89 GBq (4.73 Ci) of activity on the current date. Dosimeter calibration was carried out in a series of phases, starting with zero dose computation and progressing through reader sensitivity analysis, crystal sensitivity study, and system calibration. Through a spherical neutron survey meter, the ambient equivalent dose was also assessed at various distances. The standard, measured, and corrected dose values were compared after calculating the geometrical scattering correction factor, air scattering correction factor, room scattering correction factor, calibration factor, and response. The standard equivalent dose was used to calculate the required irradiation period for TLD. The calibration factors and response for the TLD were evaluated for both Am-Be Neutron Calibrator and Cs-137 Gamma Calibrator.

1.12. High Gamma Dose Response of Albedo TLD

H. M. Jamil, K. M. M. Morshed and M. S. Rahman

During LINAC exposure, the Albedo TLDs placed in the field get huge gamma radiation (MTS6 & MTS7). So, the gamma subtraction from the total dose to determine only the neutron dose is very important. For this reason, the TLDs need to be calibrated under high radiation exposure. In this case, we can use ^{60}Co Teletherapy Unit. Three TLDs placed in fields of 100 cGy, 200 cGy and 300 cGy in LINAC exposure are previously calibrated in ^{60}Co Teletherapy Unit located in SSDL, Savar, AERE. The irradiation time is calculated 0.74, 1.48 & 2.22 min for 100, 200 & 300 cGy, respectively, in air on the surface of ICRU Slab Phantom determined by TRS 277 dosimetry protocol. All the readings are taken by TLD Reader (RE2000, RadPro Int. GmbH, Germany) and calculated the gamma dose. During analysis, we found that all four positions shows linear response to high gamma radiation dose (both MTS6 & MTS7). In the future, these TLDs will be used for field neutron dose calculation.

1.13. Installation & Commissioning of X-ray and Mammography Calibration System

K. M. M. Morshed, H. M. Jamil, K. Fatema, S. Paul, M. M. H. Bhuiyan and M. S. Rahman

Diagnostic radiology is at the core of clinical decision-making in modern medicine. For quality control of these radiological devices, specialized instruments, such as ionization chambers, solid-state detectors, or calibrated phantoms, are used and should be periodically calibrated to ensure accurate and reliable diagnostic results. We have installed a 320kV X-ray Calibration System (Tungsten Anode) and 60kV Mammography Calibration System (Tungsten, Rhodium & Molybdenum Anode) from PTW, Germany. The integrated calibration bench (CB 60, VF Nuclear, CZ) ensures positional accuracy with perfect geometry (Measured standard deviation in X axis $\text{SD} \pm 2\text{mm}$; in Y-Axis $\text{SD} \pm 1\text{mm}$; & in Z- Axis $\text{SD} \pm 1\text{mm}$). At present, beam commissioning is ongoing to establish different beam qualities according to ISO-4037-1:2019 and 61267@IEC:2005. Detailed protocol development work is running for accurate and comprehensive documentation, record-keeping, quality assurance, and regulatory compliance. Our goal involves adjusting dosimeter/detector to maintain consistent

and traceable X-ray and mammographic dose measurements. Besides, we are also interested in calibrating detectors used in area monitoring devices and personal dosimeters in X-ray fields rather than medical.

1.14. Installation & Commissioning of Neutron Calibration System

B. N. Sattar, K.M. M. Morshed, H. M. Jamil, K. Fatema, S. Paul, M. M. H. Bhuiyan and M. S. Rahman

Neutron detectors are used in various fields, including nuclear power plants, research reactors, medical imaging, and scientific research. Neutron source with a known neutron emission rate are used to calibrate these detectors. At SSDL under the “Establishment of Calibration and Quality Control Facilities for Radiotherapy, Diagnostic Radiology and Neutron” Project we have installed a self-shielded neutron irradiator (Model: NI-03) from VF Nuclear, CZ with a standard calibration bench (Model: CB 60, VF Nuclear). This fully automated irradiation process consists of a rotary carousel for three sources with Max. neutron emission of 3×10^8 nps for Cf-252, 1×10^8 nps for Am/Be-241 and a 5.65GBq Cs-137 gamma source. The beam commissioning according to ISO guideline 2919:2012 is going on. In the near future, we will provide calibration service to Rooppur Nuclear Power Plant, Radiotherapy Facilities in Bangladesh.

2. Manpower Development

Title (training program/workshop/seminar/ symposium/ conference arranged)	Date	Place	No. of participant
11 th Follow-up Training Course, Nuclear and Radiological Emergency Preparedness	December 2022	Training Institute, AERE, Savar, Dhaka	35
Shielding Evaluation of Medical Linac Facility (Seminar)	11 August 2022	INST, Seminar Room	25 (Approximately)
Seminar-Workshop: Basics of Radiation Protection and Radiotherapy Dosimetry	21-22 March, 2023	SSDL, HPRWMU, INST	24
Seminar-Workshop: Application of Radiation in Medicine	31 May – 1 June 2023	SSDL, HPRWMU, INST	24
Seminar: Current Developments in TL & OSL Technology	15 June 2023	SSDL, HPRWMU, INST	30

3. Seminar/Symposium/Conference/Workshop/Meeting Attended

Name of the participant	Title of the event	Organizer	Date	Place
Dr. Khandoker Asaduzzaman	Interregional Meeting on Establishing and Maintaining a National Register of Sealed Radioactive Sources, Sao Paulo, Brazil, from 27 June to 1 July 2022	IAEA	27 June to 1 July 2022	Sao Paulo, Brazil
Dr. Khandoker Asaduzzaman	FNCA Hybrid Workshop on Radiation Safety and Radioactive Waste Management Project (RSRWM).	NSRA, MEXT	January 17-18, 2023	Tokyo, Japan (Online)
Engr. Shampa Paul	Training course on “PPR-2008 and Public Procurement Management”	BAEC	10-20 October 2022	Training Institute (TI), AERE, SAVAR, Dhaka.
Engr. Shampa Paul	International Physical Protection Advisory Service (IPPAS), National Workshop and Preparatory Meeting.	BAERA	1-4 August 2022	BAERA, Dhaka
Dr. Md. Mosharraf Hossain Bhuiyan, Engr. Shampa Paul and Hossein Mohammad Jamil	Application workshop on Operation and Maintenance of calibration X-ray System	PTW Germany, under SSDL ADP Project	7-17 November 2022	Freiburg, Germany

Name of the participant	Title of the event	Organizer	Date	Place
Dr. Md. Mosharraf Hossain Bhuiyan	Second Technical Meeting on Methods for Radiological and Environmental Impact Assessment (MEREIA)	IAEA	28 Nov - 02 Dec 2022	Vienna, Austria
Engr. Shampa Paul, Bushra Nufrin Sattar and Mahiuddin Ahmed	Seminar-Workshop on the application of radiation in medicine	SSDL, AERE, BAEC	May 31 – June 01, 2023	SSDL Building, AERE Campus
Bushra Nufrin Sattar and Mahiuddin Ahmed	Seminar-Workshop on Basics of Radiation Protection and Radiotherapy Dosimetry	SSDL, HPRWMU, AERE, BAEC	March 21-22, 2023	SSDL Building, AERE Campus.
Bushra Nufrin Sattar	FTC on Reactor Engineering Course at BAEC (RECB-10)-2023	Training Institute, AERE, BAEC	Feb 12- March 02, 2023	Training Institute, AERE, BAEC
Bushra Nufrin Sattar and Mohammad Habibur Rahman	FTC on Nuclear and Radiological Emergency Preparedness Course at BAEC-2022	Training Institute, AERE, BAEC	December 04-15, 2022	Training Institute, AERE, BAEC
Mahiuddin Ahmed	Seminar on Clinical Commissioning of Radiotherapy Treatment Planning System using Thorax Phantom	MPD, AECD, BAEC	February 23, 2023	Auditorium, AEC, Dhaka
Mahiuddin Ahmed	Workshop on Monte Carlo Simulation for Medical Physics Application	INMP, AERE, BAEC	February 13-14, 2023	INMP, AERE, BAEC
Engr. Shampa Paul	Current development in TLD and OSL technology	SSDL, HPRWMU, AERE	11-15 June 2023	SSDL, HPRWMU, INST
Md. Fakhar Uddin	Interregional Meeting on Quality Management for the Safety and Security of Disused Sealed Radioactive Sources and Radioactive Waste, Windhoek, Namibia, from 3 to 7 October 2022 (ME-INT9186-2000454)	IAEA	3 to 7 October 2022	Windhoek, Namibia
Md. Fakhar Uddin	Self-assessment of Emergency Arrangements and Use of ERIMS	IAEA	21-25 May, 2023	BAERA, Dhaka
Bidhan Chandra Sutradhar	e-Nothi Office Management	ICS, AERE, BAEC	08-12 January, 2023	ICS, AERE, BAEC
Md. Abdur Rahim	FTC on Environmental Radioactivity Monitoring Course at BAEC (ERMC-10)-2023	Training Institute, AERE, BAEC	15-19 January, 2023	Training Institute, AERE, BAEC
Md. Ashikur Rahman	International Training Course on the Security of Non-Nuclear Radioactive Material in Transport	IAEA	19 to 23 September 2022	Kuala Lumpur, Malaysia
Md. Ashikur Rahman and KM Mahbub Morshed	Bangladesh National Training Course on Nuclear Material Accounting and Control for Nuclear Security Purposes at Facilities	IAEA	15 to 17 November 2022	Saint Petersburg, Russian Federation
Md. Ashikur Rahman	International School on the Physical Basis for Radionuclide Migration	ICTP-IAEA	07 - 11 Nov 2022	ICTP, Italy

Name of the participant	Title of the event	Organizer	Date	Place
	(Storage, disposal and contaminated sites)			
Md. Ashikur Rahman	FRN Methods Focusing on Cs 137 and Pb-210 for Erosion Assessment and Field Work for Designing the FRN Study	IAEA	13-26 Feb 2023	HQ, BAEC
Hossen Mohammad Jamil	Meeting on Protocol Development for System Accreditation and Workshop on Operation & Maintenance of TLD System	RadPro International GmbH	25 August-02 September 2022	Frankfort, Germany
Hossen Mohammad Jamil, KM Mahbub Morshed and Dr. Md. Mosharraf Hossain Bhuiyan	Seminar-Symposium: Celebration of International Medical Physics Day	Bangladesh Medical Physics Association	24 November 2022	NINMAS, Dhaka, Bangladesh
Hossen Mohammad Jamil and Dr. Md. Shakilur Rahman	National Conference of Physics - 2023	Bangladesh Physical Society	9-11 March 2023	Jahangirnagar University, Dhaka, Bangladesh
Hossen Mohammad Jamil and Dr. Md. Shakilur Rahman	Sylhet Cancer Congress-2023	Sylhet Cancer Research Group	5 May 2023	Sylhet, Bangladesh
Hossen Mohammad Jamil and Dr. Md. Shakilur Rahman	Seminar: Basics of Radiation Protection & Radiotherapy	TMSS Cancer Center, TMC & RCH	10 June 2023	TMSS, Bogura, Bangladesh
Hossen Mohammad Jamil, Engr. Shampa Paul, Dr. Md. Mosharraf Hossain Bhuiyan, Bushra Nufrin Sattar, KM Mahbub Morshed and Mahiuddin Ahmed	Seminar-Workshop: Basics of Radiation Protection and Radiotherapy Dosimetry	SSDL, HPRWMU, INST	21-22 March, 2023	Dhaka, Bangladesh
Hossen Mohammad Jamil, Engr. Shampa Paul, Dr. Md. Mosharraf Hossain Bhuiyan, Kanij Fatema, Bushra Nufrin Sattar, KM Mahbub Morshed and Mahiuddin Ahmed	Seminar-Workshop: Application of Radiation in Medicine	SSDL, HPRWMU, INST	31 May – 1 June 2023	Dhaka, Bangladesh
Hossen Mohammad Jamil, Engr. Shampa Paul, Dr. Md. Mosharraf Hossain Bhuiyan, Bushra Nufrin Sattar, KM Mahbub Morshed and Mahiuddin Ahmed	Seminar: Current Developments in TL & OSL Technology	SSDL, HPRWMU, INST	15 June 2023	Dhaka, Bangladesh

4. Stakeholder Meeting:

- Meeting of service provider HPRWMU with the service recipient stakeholders of AERE, Savar on December 13, 2023 under Service Delivery Commitment Action Plan 2022-2023.
- Meeting of Service Provider SSDL, HPRWMU with Service Recipient Stakeholders from various Institutions/Industries on September 22, 2022 on ZOOM Platform under Service Delivery Commitment Action Plan 2022-2023.

5. Collaboration work/MoU:

- ADP: Establishment of Calibration and Quality Control Facilities for Radiotherapy, Diagnostic Radiology and Neutron. Dr. Shakilur Rahman
- FNCA project on Radiation Safety and Radioactive Waste Management; Dr. Khandoker Asaduzzaman
- Special allocation project of Ministry of Science and Technology, 2022-2023: Developing the Preliminary Site Selection Capabilities for the Disposal of Low and Intermediate Level Radioactive Waste (LILW) in Bangladesh. Dr. Md. Idris Ali and Md. Abu Haydar
- Special Allocation Project of Development and characterization of radiation shielding materials based on indigenous raw materials. Dr. Md. Mosharraf Hossain Bhuiyan

6. Lectured Delivered

- Lecture delivered on 'Nuclear and Radiological Emergency Preparedness' in Instructor Training Course (ITC) 27 November to 1 December 2022, Japan by Engr. Shampa Paul.
- Lecture delivered on Introduction to Gamma Spectrometry by HPGe detector in Seminar-Workshop on Basics of Radiation Protection and Radiotherapy Dosimetry, SSDL Building, AERE Campus, March 21, 2023 by Mahiuddin Ahmed.

7. Service Rendered and Revenue Income

Name of service	Quantity of sample	Revenue income
Radiation Survey	140	313,000/-
Calibration and Standardization	180	1,092,000/-
Radioactive source/waste interim storage	10	721,420/-
Environmental sample analysis	219	-
Total		2,126,420/-

8. Repair & Maintenance work(s)

- Repair and maintenance of Am-Be Neutron Calibrator (OB-26, Germany);
- Renovation of the Ground Floor of the SSDL building, including- the construction of a Console Room for the X-ray & Mammography Calibration System and a Console Room for the Neutron Calibrator System;
- Repair of Door sensor for X-ray & Mammography Calibration lab.
- Construction of Secondary fencing around the SSDL Building (Ongoing).

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. Research and Development Work(s)

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
- Neutronics analysis of nuclear reactors
- Thermal hydraulics and Safety studies of nuclear reactors

2. Manpower Development and Training Programme

Title of the event	Date	Place	No. of participant
Training Course on PPR-2008 and Public Procurement management-2022	10-20 October, 2022	TI, AERE Savar, Dhaka	01
E-Nothi Office Management	08-12 January, 2023	ICS, AERE Savar, Dhaka	01

3. Seminar/Symposium/Conference/Workshop/Meeting Attended

Name of the participant	Title of the event	Organizer	Date	Place
Dr. Badrun Nahar Hamid	Technical Meeting on State-of-the-art Thermal Hydraulics of Fast Reactors (Virtually)	Brasimone Research Centre, Camugnano, Italy	26-30 September 2022.	RPED, INST
Dr. Mohammad Abdul Motalab	Development of Neutronic and Thermal-Hydraulic Coupled Computational Methodologies for Research Reactors Including Analysis and Treatment of Uncertainties	IAEA	29 Nov. - 02 Dec., 2022	Vienna, Austria
Dr. Md. Jahirul Haque Khan	4 th International Conference on Energy and Power (ICEP-2022)	MIST, Dhaka	11-13 December, 2022	MIST, Dhaka
Dr. Muhammed Sohel Rana	International Conclave on Materials, Energy & Climate	Dhaka University	19-20 December, 2022	Dhaka University
Dr. Md. Jahirul Haque Khan, Sardar Muhammad Shauddin	Workshop on Monte Carlo Simulation for Medical Physics Application	INMPH, AERE, Savar, Dhaka	13-14 February, 2023	INMPH, AERE, Savar, Dhaka
Dr. Badrun Nahar Hamid	1 st International Dhaka Science Conference for Women-2023	Dhaka Nanomaterial Group	15-16 February, 2023	Hotel Pan Pacific, Sonargaon, Dhaka
Dr. Mohammad Abdul Motalab	Development of Neutronic and Thermal-Hydraulic Coupled Computational Methodologies for Research Reactors Including Analysis and Treatment of Uncertainties	IAEA	27-31 March 2023	Argonne National Laboratory, Lemont, USA
Mohammad Sayem Mahmood	Russian Federation-IAEA Advance Nuclear Energy Management School (EVT2205144)	Russian Federation	05-09 June, 2023	St. Petersburg, Russian Federation

Tandem Accelerator Facilities Division, INST

Objective

One of the big facilities established in AERE is a3MV Tandem Accelerator, was procured by BAEC under an Annual Development Project of the Government of Bangladesh and installed on the AERE Campus, Savar, in

2010. The complete accelerator system has been manufactured by the High Voltage Engineering Europa BV, The Netherlands. The proton beam of energies up to 6MeV is available at the accelerator. It had been successfully used for analytical work using the particle induced X-ray emission (PIXE) technique. Recently it was adapted to measure also nuclear reaction cross sections, especially of low threshold reactions, whose databases are rather weak. Furthermore, investigation of the (p, γ) process on light-mass isotopes of a few elements near the reaction threshold is of considerable significance in astrophysics. A highlight of this new activity was the measurement of cross sections for the production of the novel positron emitter at a low-energy cyclotron. The need and importance of such measurements in the production of novel positron emitters have been recently emphasized, especially in view of the solution targets being developed at small cyclotrons.

The main objective of this division is to keep the complex accelerator system operational and provide ion beam for doing research. The other objectives are the following:

- To train manpower in advanced nuclear technology
- To study basic nuclear phenomena
- To provide valuable data/information for various fields of applied sciences
- To study various environmental pollution in the country
- To help students to obtain academic degrees

Activities

1. Research and Development Work(s)

1.1 Development of in air particle induced X-ray emission set-up.

M. M. Hasan, M. A. Shariff, M.S. Uddin and A.K.M. Shafiq Ullah

Particle induced X-ray emission referred to as PIXE is one of the most popular elemental analysis methods in ion beam analysis techniques. In normal PIXE method, ion beam is irradiated in high vacuum chamber. So, sample preparation is one of the important and concerning stages of this method considering the stability of the target sample in high vacuum environment. The main objective of establishing in air PIXE setup at the Tandem Accelerator Facility is to perform experiment on samples which cannot withstand high vacuum such as biological samples, delicate samples, seeds, etc. Some parts of this setup are constructed from Ruder Boskovic Institute, Croatia under IAEC TC project and major part developed and constructed locally. The setup is tested satisfactorily to maintain high vacuum. So, the ion beam can be safely transport in Air on the target sample. An ion beam chopper is also be designed and constructed to measure current of the beam in this respect. A special table for this set up has also been constructed. The in air PIXE setup can be used for plant mutation breeding in future.

1.2 Possibility of production of the radio tracer ^{85}Sr

M.S. Uddin

The radionuclide ^{85}Sr ($T_{1/2} = 64.9$ d) is a useful tracer in agricultural and environmental studies. In fact ^{85}Sr is the only longer lived tracer of strontium which can be conveniently used. The radionuclide is commercially available with low specific activity for tracer studies but also as a standard for γ -ray spectroscopy. The radionuclide ^{85}Sr is generally obtained in small amounts via the $^{84}\text{Sr}(n,\gamma)$ -reaction in a nuclear reactor using a $^{\text{nat}}\text{Sr}$ target, because the abundance of ^{84}Sr in $^{\text{nat}}\text{Sr}$ is only 0.56 % and σ_{th} for the process is also small. The resulting yield and specific activity of ^{85}Sr are therefore low. To obtain higher specific activity, a new production route, namely $^{85}\text{Y} \rightarrow ^{85}\text{Sr}$ precursor system is useful.

To develop new possible production route, cross sections of the $^{86}\text{Sr}(p,x)^{85}\text{Sr}$ reaction from the respective threshold up to 44.1 MeV were obtained through measurements on 96.4 % enriched $^{86}\text{SrCO}_3$ as target. Thin targets prepared by sedimentation were irradiated with protons in a stacked-form, and the induced radioactivity was measured by high-resolution γ -ray spectrometry. Nuclear model calculations based on the code TALYS reproduced our experimental cross section data well. From the excitation function, the integral yield of the above radionuclide was calculated. The yield of ^{85}Sr via the $^{\text{nat}}\text{Sr}(n,\gamma)$ process was also measured using the

TRIGA Mark-II reactor at AERE, Savar. The production route $^{nat}\text{Sr}(p,x)^{85}\text{Sr}$ at a 30 MeV cyclotron could compete with the $^{nat}\text{Sr}(n,\gamma)$ -route at a reactor, if the specific activity is not a problem. An alternative $^{86}\text{Sr}(p,2n)^{85}\text{Y} \rightarrow ^{85}\text{Sr}$ precursor route investigated in this work leads to no-carrier-added ^{85}Sr in sufficient quantity.

1.3 Experimental and theoretical studies of cross sections of the $^{86}\text{Sr}+p$ processes and isomeric cross-section ratios for $Y^{86m,g}$ and $Y^{85m,g}$

M. Shuza Uddin

Studies of excitation functions of charged-particle induced nuclear reactions on medium-mass target nuclei are of considerable significance for enhancing the understanding of nuclear theory as well as for practical applications. Regarding nuclear theory, several advanced nuclear model codes, incorporating mainly compound and precompound interactions, have been developed in recent years to describe the reaction cross section in the low to intermediate energy range. Precision experimental measurements allow to test those model codes. The work described here entails experimental determination of the excitation functions of the processes leading to the formation of the relevant radionuclides, and detailed nuclear model calculations to interpret and understand the reaction mechanisms involved. A special focus is on the isomeric cross-section ratios, studied over the proton energy range up to 44 MeV.

Cross sections of proton-induced nuclear reactions on enriched ^{86}Sr target were measured by the activation technique up to proton energies of 44 MeV. The isomeric cross-section ratios for $Y^{86m,g}$ and $Y^{85m,g}$ as a function of projectile energy were deduced from their measured data. The present experimental data for the nuclear reaction products, namely Y^{86m} , Y^{86g+xm} , Y^{85m} and Y^{85g} were compared with the results of nuclear model calculations using the code TALYS, which combines the statistical, precompound, and direct interactions. In general, the experimental cross section data as well as the isomeric cross-section ratios are reproduced well by the model calculations, provided the input model parameters are properly chosen and the level structure of the product nucleus is thoughtfully considered. The quality of the agreement between experimental data and model calculations, was numerically quantified. For products formed via emission of a light complex particle as well as multi-nucleons (e.g., α and $2p2n$), the contribution of the latter process starts increasing when its energy threshold is crossed.

2. Repair, Maintenance and Renovation Works

- Regular operation of High vacuum system of 3 MV Tandem Accelerator.
- Regular maintenance of 40 KVA main UPS, 2KVA control room UPS and 15 KVA water cooling system UPS
- Main PCB of water cooling system is repaired.
- Problem found in SW Magnet water sensor is fixed by adjusting F2 potentiometer.
- 358 source is in operational condition by overcoming regulation error problems related to filament program, filament monitor, magnet program and magnet monitor on 358 source power supply.
- The repaired Radiofrequency driver unit is installed and adjustment procedures are going on.
- Connecting wire of output stage PCB is soldered and reconnected in driver unit.
- HPGe detector test using pulsar, amplifier, ADC and oscilloscope.
- Resolution test of HPGe detector using ^{55}Fe X-ray source.
- Test of new lithium drifted silicon $\{\text{Si}(\text{Li})\}$ detector by using pulsar, amplifier, ADC and oscilloscope.
- Data acquisition problem as spectrum does not fit in channel C is fixed by changing the connecting cable between MPA-3 and ADC.
- Regular repair and maintenance of Main PCB, magnetic contactor and fan motor of Central Air Cooler System.

3. Seminar/Symposium/Conference/Workshop/Meeting Attended

Name of the participant	Title of the event	Organizer	Date	Place
Md. Mehedi Hasan	International Conference on Electronics and Informatics 2022, Theme: Emerging Technologies in Electronics and ICT for the Sustainable Development.	Bangladesh Electronics and Informatics Society.	26-28 January 2023.	Atomic Energy Centre, Dhaka, Bangladesh

4. Collaboration Work/MoU

IAEA-TC PROJECT TITLE: Strengthening Capacity in the Maintenance and Utilization of the Tandem Accelerator Facility, Code: BGD 0010, Period: 1-1-2018 to Continue.

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 developed

Unfortunately, out of fourteen scientific visits and fellowships, we managed to attend only seven 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 the main achievement so far. We received some important nuclear equipment procured through the project, which are otherwise difficult to obtain. We are still waiting more equipment to come.

Isotope Hydrology Division, INST**Objectives**

The Isotope Hydrology Division has set its aim to apply the isotope techniques in the following areas.

- Understanding the groundwater origin, recharge mechanism, residence time, flow dynamics, and relationship between different aquifer systems;
- Developing isotope fingerprints of water to study climate change phenomena through isotope ($\delta^{18}\text{O}$, $\delta^2\text{H}$ and ^3H) monitoring in precipitation under IAEA-GNIP network;
- Investigations of surface water and groundwater interactions, water pollution, source and transport mechanisms of pollutants and biogeochemical behaviour of contaminant;
- Identification of recharge and discharge zones catchment areas;
- Identifying the seepage and leakage from dams/dykes and reservoirs/canals;
- Investigations of possible sources of salinity in groundwater aquifers in coastal regions of Bangladesh;
- Application of nuclear techniques (Fall-out Radio Nuclides) in assessment of riverbank erosion, soil erosion and soil deposition.

Activities**1. Research and Development Work(s)****1.1 Groundwater quality assessment using stable isotopes and hydrogeochemistry in Tangail district, Bangladesh.**

R.K. Majumder, M. Moniruzzaman, M.A.Q. Bhuiyan and M. A. Ahsan.

The groundwater system of Tangail district is little bit complex in terms of its geology. It is bounded by flood plains of the Jamuna River in its western part and uplifted Pleistocene terrace in eastern part. These two distinct surface geological conditions influence the groundwater quality in the study area. Total 80

groundwater and river water samples were collected from Tangail district. The main objectives of this study were to analyze the origin, recharge mechanisms and mixing of water using stable isotope technique to assess hydrogeochemical characteristics of the underlying groundwater aquifers. The groundwater $\delta^2\text{H}$ isotopic compositions of Tangail district ranged from -43.5 to -9.6‰; with an average of -26.43 ‰ and $\delta^{18}\text{O}$ values ranged from -6.84 and -2.07‰ with an average of -4.57 ‰. The $\delta^2\text{H}$ and $\delta^{18}\text{O}$ values of Jamuna floodplain portion of Tangail district fall close to the global meteoric and local meteoric water lines, which provides compelling evidence that all groundwaters is derived from rainfalls and flood water with a minor localized evaporation effects for the groundwaters. On the contrary, groundwater samples of Madhupur Tract are more enriched which indicates that comparatively old recharge. The enrichment of Mg^{2+} , Na^+ , K^+ , and HCO_3^- indicate high water-rock interaction. Excessive use of fertilizer in agricultural field results in high concentration of SO_4^{2-} and NO_3^- in the shallow aquifer. The deep groundwater is comparatively fresh. Careful use of groundwater is highly recommended for sustainable management of groundwater resources in Tangail district area.

1.2 Assessment of Groundwater Source, Contamination, and Health Risk Assessment of Meherpur District, Bangladesh

R.K. Majumder, M. Moniruzzaman, M. A. Q. Bhuiyan and M. A. Ahsan.

This investigation aims to assess groundwater quality in three Upazilas in Meherpur districts of Bangladesh. The hydrogeochemistry of water was examined using physicochemical parameters such as pH, Electrical Conductivity, Total Dissolved Solids, Redox potential, Manganese, Iron, Arsenic, Calcium, Magnesium, Sodium, Potassium, Fluoride, Chloride, Sulfate, Bicarbonate, and Nitrate. The drinking water suitability was verified using WHO standards. The analysis results were interpreted using geology, geomorphology, and geochemical diagrams. 54% of shallow and 7% of deep water were deemed unsuitable for drinking, while SAR and MAR values indicated suitable for irrigation. 43% and 46% shallow groundwater were contaminated with Nitrate and Arsenic respectively, posing health hazards to residents and the ecosystem.

1.3 Investigation of Groundwater in Eastern Part of Kushtia District, Bangladesh: Quality, Source, Interaction, and Potential Health Risks

Ratan Kumar Majumder, M. Moniruzzaman, M. A. Q. Bhuiyan and M. A. Ahsan.

A hydrogeochemical and isotopic analysis was conducted in the Gorai River and its aquifers in Kushtia district, to assess the interaction between rivers and groundwater. The analysis evaluated water quality, health risks, groundwater sources, and recharge mechanisms, major anions, cations, heavy metals, and stable isotopes of water. The hydrogeochemical analysis of groundwater in the area shows high concentrations of Ca^{2+} , HCO_3^- , Fe, Mn, and As. Weathering minerals, agricultural activities and anthropogenic sources influence the composition. The stable isotope analysis revealed limited recharge into the alluvial aquifer by the river, suggesting that groundwater primarily originates from local precipitation. The Entropy Water Quality Index indicates drinking water, while Sodium and Magnesium Adsorption Ratios suggest irrigation. However, Arsenic poses a significant health risk to residents.

2. Repair, Maintenance and Renovation Works

2.1 Establishment of Gamma Spectrometry Laboratory

Gamma Spectrophotometer Laboratory was established under the IAEA TC support (BGD5033) to assess river bank erosion processes for land management strategy to prevent and reduce flood and river bank erosion using nuclear techniques like Fallout Radionuclides (FRN), Compound Specific Stable Isotope (CSSI) analyses methods and water isotopes for soil moisture assessment.

2.2 Maintenance of the Ion Chromatography (IC) system

The Ion Chromatography (IC) system was installed in 2009 and has long been utilized to analyze anions in water samples. Recently, there was problem with the pump drive of the IC which was replaced.

3. Manpower Development and Training Programme

Title of the event	Date	Place	No. of participant
Genie 2000 software training course organized by CANBERRA PACKARD, Central Europe	24-28 July 2022	Gamma Spectrometry Lab, Isotope Hydrology Division, INST, BAEC)	10
IAEA-TC Training Course entitled “Theoretical and Practical FRN Methods Focusing on Cs-137 and Pb-210 for Erosion Assessment and Field Work for Designing the FRN Study	13-26 February 2023	Seminar Hall (9 th Floor), BAEC Headquarters, ParamanuBhaban, Sher-E-Bangla Nagar, Dhaka-1207	36

4. Seminar/Symposium/Conference/Workshop/Meeting Attended

Name of the participants	Title of the event	Organizer	Date	Place
Dr. Md. Moniruzzaman	Isotopic and hydrogeochemical assessment of groundwater aquifers in southcentral part of Bangladesh: Implications for vulnerability of groundwater resources	49 th International Association of Hydrogeologists(IAH) congress	19-22 Sept. 2022	Wuhan, China (Online)
Dr. Ratan Kumar Majumder	First Research Coordination Meeting on Understanding the Importance of Convective Rain Events and Tracing Their Impact on the Catchment with Isotopes	IAEA	25 to 28 April 2023	Vienna, Austria

5. Collaboration Work

5.1 IAEA-TC Program (BGD5033):

Title: Using Nuclear Techniques in Assessing River Bank Erosion.

Period: June, 2019- December, 2022

Background Information:

River bank erosion is a major environmental problem in countries with large alluvial plains and river deltas such as Bangladesh, which is situated in lowest part of the river basins of several huge rivers such as Ganga, Brahmaputra, Barak (Meghna), Tista (Bengal Plain). These rivers have very high discharge and very high seasonal variability due to monsoon climate and impact of Himalayas and Tibet mountainous areas occupying upper part of their watersheds. Melting snows and glaciers as well as monsoon rainfalls result in frequent flooding. Among the consequences of this extreme hydrological regime of major water courses there is severe river bank erosion. Flooding is moreover connected with intensive sedimentation and with erosion of sea coast in one areas and dryland expansion in other areas. The consequences involve loss of land, damage to property and infrastructure. River bank erosion is not an accidental and isolated hydraulic phenomenon. It is closely related to the hydrological regime and sediment transport in the whole watershed. The impact of the water flows and water discharge is relatively simple. The more water, the higher the speed the higher seasonal variability the more river bank erosion. But much more difficult is the impact of the suspended sediment load. On one hand it may encourage the river bank erosion because it is filling the reservoirs, and some slowly flowing watercourses such as irrigation channels, what may cause higher discharge variability and concentration of flows in those channels which are permeable. But on the other hand, it protects the land from river bank erosion, because water course full of suspended sediment does not have erosion and transporting capacity, while clean water is “hungry” of suspension and erodes much more. Therefore, the suspended sediment load is important factor controlling the river bank erosion and should be studied carefully. Obtaining information on the sediment load of a river must be seen as a key requirement in any attempt to understand the sediment dynamics of a river basin, by quantifying the amounts of sediment involved.

Objectives:

The prime objectives of this study are:

1. Characterization of the geographical conditions of affected area,
2. Characterization of land use and agriculture in affected area.
3. Characterization of erosion phenomena.
4. Assessment of the problem
5. Formulation of strategy for prevention and mitigation of flood and erosion
6. Identification of the role of nuclear techniques to be used for this purpose in combination with conventional techniques.

Study Area:

Flood-prone area of Bengal Plain, Ganga-Brahmaputra catchment and delta, Bangladesh.

Methodology:

Apart from conventional techniques following isotopic techniques will be used-

1. FRN methods: ^{137}Cs and ^{210}Pb (eventually $^{239+240}\text{Pu}$ and ^7Be)
2. Total abundance stable isotope analyses: mainly ^{13}C , eventually ^{15}N
3. Compound specific stable isotope (CSSI) analyses of ^{13}C , eventually ^{15}N
4. Water isotopes for soil moisture assessment $\delta^{18}\text{O}$, $\delta^2\text{H}$.
5. Neutron probe.

Expected project outcomes and its impact:

It is expected that this study will be useful in characterization of the erosion phenomena and will be helpful in formulation of strategy for prevention and mitigation of flood and erosion.

5.2 IAEA, RCA project RAS7040:

Title: Improving Water Resources Management Practices by Enhancing the Regional Collaboration in Environmental Isotope Analysis and Applications

Period: 2022-2026

Objectives (to Align With the Main Objectives of the RAS7040):

- To develop multi-isotopes using techniques ($^{87}\text{Sr}/^{86}\text{Sr}$, $\delta^{81}\text{Br}$, $\delta^{11}\text{B}$, ^3H and ^{14}C), data interpretation and modeling to assess the origin, source and seawater mixing
- Identification of the origin of groundwater salinity in the south-western coastal region of Bangladesh
- Mapping the regional geographic distribution of salinity prone coastal aquifers for the future sustainable groundwater management
- To inform the focal organizations and government of Bangladesh for the sustainable management and proper use of salinity free water for the future generation.

Study Area: The study area is comprised of south-western coastal region of Bangladesh. The southwest region of Bangladesh showing the coastal region, the Sundarbans, the Gorai River and the Rupsa-Pasur River. The southwest coastal region of Bangladesh, being under tidal influence and dependent on sweet water supplies from upstream, has a unique brackish water ecosystem. The topography is relatively flat and the elevation ranges from -0.41 to 10.38 mPWD with distinct slope from north to south. The area comprises deltaic floodplains of the Delta are undergoing rapid hydro morphological changes due to natural and anthropogenic causes which is overlies Pleistocene and Holocene formation. The study area located on moribund and matured deltaic deposit, where some deltaic wetland area situated. The deltaic wetlands are under threat due to extension of agricultural land use, shrimp cultivation, and saline water intrusion in the tidally domain delta region. The hydrology of the south-central Bangladesh is complex because of the complicated interfering of moribund and matured deltaic deposit with marine regressions and transgressions. Mainly three aquifers are found here, upper shallow, lower shallow and deep aquifers. However, many areas are found only two aquifers. According to the BWDB and DPHE reports, aquifer system in this area is extended to more than 300m depth, while thickness of aquitard is found relatively thin and some areas third aquifer (>250m depth

usually) is confined by relatively thicker aquitard. This area receives a total annual precipitation of approximately 2000mm and the temperature varies between 15 (January) to 35 °C (May). 70% of the total rainfall occurs during the monsoon (June-September). Dry season Water level of the study area varies within 2 to 3 meters depth from the top surface. However, the range is lifted to 0 to 1 m in rainy season.

Methodology: We aim to collect 60 to 70 samples per season from different depths and in total it will provide 240-280 samples finally at a frequency of twice a year in two years. The sampling campaign will be conducted for two years, while each of the year will have two periods/ seasons for collection, i.e., monsoon and non-monsoon. The parameters to be analyzed includes: Physicochemical: EC, pH, Eh, Temperature, TDS, DO, Major cations and anions, SiO₂, Trace elements: Fe, Mn, As, Sr, F-, Br-, Ba, Stable isotopes: O-18, H-2, C-13, N-15, Radioactive isotopes: H-3, C-14.

Expected project outcomes and its impact:

- Knowledge gaps about the origin of groundwater salinity in the south-western region of Bangladesh, i.e., whether the salinity comes from present seawater intrusion due to rising of sea-level or it is old water/connate water
- The coastal belt of Bangladesh is severely impacted by arsenic and salinity intrusion. Scarcity of supplying salinity free drinking water to the peoples
- Absence of use isotope techniques for identification of origin and residence time of sea water intrusion and salinity problem.

End Users: Bangladesh Water Development Board, Department of Public Health Engineering and Bangladesh Metrology Department.

5.3 IAEA-GNIP project

Title: Global Network for Isotopes in Precipitation.

Period: 2009 – ongoing)

Background Information:

Isotopic analysis is very common for large domains. However, it may be significant for small domain like Bangladesh which may help to understand the environmental controls over precipitation. Bangladesh is in the subtropical monsoon climate region having extensive seasonal variations in rainfall amount, humidity and high temperatures. Bangladesh maintains total 8 GNIP stations for precipitation sample collection aiming isotopic analysis. About 75% of the total rainfall amount in a year is recorded during the monsoon period. Relatively lower amount of rainfall is experienced by the west-central, central and east-central parts of Bangladesh. Annual rainfall varied in the range of 1200–1400 mm in those regions for the period of 1961–2010. For the same period, the range was 2400–2600 mm in the northeastern re Bangladesh maintains a total of eight GNIP stations for precipitation sample collection aiming isotopic analysis. Dhaka (SR), Chuadanga (CN), Dinajpur (DN), Barisal (BS), Satkhira (KH), Sylhet (HT), Bandarban (BN) and Cox's Bazar (XB) are the eight stations placed in diverse climatic and geographic zones throughout the country. Dhaka (SR) is in the central part of Bangladesh; BS, KH and XB are three coastal stations; DN is in the northwestern part of the country; CN is located in the south-central part of Bangladesh. For the sample collection process, mainly two types of rainfall collectors are used in Bangladesh. The old setup is comprised of a High-Density Polyethylene (HDPE) bottle and a funnel while a Ping-Pong ball is placed at the funnel mouth to prevent evaporation during rainfall. Recently three of the stations (XB, HT, SR) are using PALMAX (Croatia) rainfall collector. Whichever the type, the rain collector is placed in an open space to collect the rain. Collected rainwater is immediately transferred after each rainfall event to a bottle which is kept sealed and stored inside a room. At the end of the month, monthly composite sample is prepared from the collected event-based samples. Analysis was done by Liquid Water Isotopic Analyzer (LWIA) in Isotope Hydrology Laboratory of BAEC and IAEA, Vienna, Austria. The isotopic results are expressed as δ -values and in ‰ (per mil.) unit, which are relative to VSMOW (Vienna Standard Mean Ocean Water) on a normalized scale.

$$\delta(\text{‰}) = (R_{\text{sample}} - R_{\text{standard}}) / R_{\text{standard}} \times 1000$$

Where, R refers to the 18O/16O or 2H/1H ratio. Results of the isotopic analysis and meteorological data were collected from WISER database of IAEA. Total 297 monthly samples have been used in this study from those stations having the collection period of 2009–2017. Most of the stations were operational since 2014 while

observation of HT and SR stations were started from 2009. Observation of meteorological variables, including the precipitation amount (P, mm), temperature (T, °C), relative humidity (RH, %) and vapor pressure (Vp, hPa) were available at each GNIP stations except in BN. BN shares the meteorological data from its nearest meteorological observatory station in Rangamati. All isotopic and most of the meteorological data are taken from IAEA-WISER database (WISER 2018). A portion of meteorological data was used from Reliable Prognosis (RP5 2018). Each of the stations have either geological or climatic differences. The daily samples analysis has done by Liquid Water Isotope Analyzer (LWIA) at IHD lab. The monthly samples have been sending to IAEA in every year.

End Users: Bangladesh Metrology Department, Bangladesh Water Development Board and Department of Public Health Engineering, Delta-Plan Project.

5.4 IAEA CRP (26598)

Title: Convective Rain Events in the Surma-Kushiyara River Catchment of Bangladesh and Tracing their Impact on the Catchment with Isotope (CRP Number 26598).

Period: 2023-2026

Scientific Background:

The Surma-Kushiyara river catchment is a marshy wetland ecosystem of north-eastern Bangladesh. This wetland plays a key role in production of Boro rice irrigated by wetland water planted from December to early February and harvested between April and May. But now a days this wetland is affected by climatic variations such as scarcity of convective rain events and extreme early flooding due to heavy convective rain events causing a threat to the hydrodynamic behavior of the wetland ecosystem in the Surma-Kushiyara river catchment areas.

Hence, the Surma-Kushiyara river catchment areas has become one of the most important environmental issues in Bangladesh for sustainable water resources development and proper land-use management. For this a comprehensive isotopic as well as hydrogeological, hydrochemical assessments are needed for better understanding the pattern and frequency of the convective rain events in time and space and their impact on the Surma-Kushiyara river catchment areas of northeastern Bangladesh.

Scope of the Project:

Stable (O-18, H-2) and radioactive (H-3) isotopes in water molecules are powerful tools for the tracking of the path of water molecules in the water cycle, from precipitation to surface and groundwater. Water isotopes are commonly used to trace the source of water and its flow pathways or to quantify exchanges of water, solutes, and particulates between hydrological compartments during different hydrological processes. Besides, Radon-222 a naturally occurring radioactive isotope can be used as a natural tracer in groundwater-surface water interaction studies. In the present proposed project, water isotopes as well as radon-222 along with conventional hydrochemical methods will be used to understand the importance of convective rain events as well as tracing their impact on the Surma-Kushiyara river catchment tracing isotopes. Moreover both water chemistry (physicochemical parameter, anion, cation and trace elements) and isotopic tools applications will identify the source and mixing pattern of groundwater and surface water system.

Objectives:

The specific objectives of the project are as follows:

1. To understand the nature and frequency of convective rain events in time and space in the Surma-Kushiyara river catchment;
2. Measuring the surface runoff within the catchment area;
3. To assess the nature and degree of surface and groundwater mixing;
4. To analyze the water chemistry of groundwater and surface water system
5. To understand the groundwater recharge mechanisms, residence time and flow dynamics within the aquifers;

6. To evaluate the hydrochemical processes in the aquifer system;
7. Finally, the research results would help to understand the influence of convective rain events in the Surma-Kushiyara catchment area and tracing their impact using isotopes along with conventional hydrological and hydrochemical techniques which would help to develop a sustainable cropland irrigation management in the Surma-Kushiyara catchment area for higher productivity of rice as well as will help to restore the ecosystem of the catchment area.

Overall program of work for whole duration of the contract:

- 1) Collection of hydrological data such as rainfall, evaporation, evapotranspiration, surface water level, groundwater level, soil moisture content, borelog, GIS maps of the study area;
- 2) Set up of rainfall collector to collect high frequency rain events as well as to collect daily and monthly rainfall;
- 3) Pre-monsoon (November-May) and monsoon (June-October) sampling of groundwater and surface water;
- 4) Isotopic and hydrochemical analyses of rainfall, groundwater and surface water;
- 6) Preparation of geological and hydrological maps;
- 7) Interpretation of both isotopic and hydrochemical data;
- 8) Aquifer mapping and modeling using available software;
- 10) Data compilation and report writing;
- 11) Seminar/workshop at the end of the project.

Expected outputs:

1. Better understanding the effect of convective rain events on catchment hydrological systems tracing with isotopes and conventional techniques which would provide a good insight into the hydrological links between convective rainfall, wetlands water and underlying groundwater within the catchment environment;
2. Dissemination of knowledge of isotope techniques used in water resources development in the Surma-Kushiyara river catchment area to the focal agents and the governments;
3. Research outcomes will be utilized for the sustainable water resources management in Surma-Kushiyara river catchment area;
4. Outcomes will also be helpful for management of wetland hydro-ecology;
5. Research publications.

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.

Activities

1. Research and Development Work(s)

Neutron Activation Analysis

1.1 Temporal Variation of Natural Radioactivity Concentrations in Sediment Cores of the Sundarban Mangrove Ecosystem

M.A. Islam, K. Naher, R. Khan, U. Tamim, M.A. Azam, I. Khalil, M.S. Islam, A. Ullah and M.S. Uddin

The naturally occurring radionuclides ^{226}Ra , ^{232}Th , and ^{40}K in sediment cores (~50 cm long) from different Ranges of the Sundarban mangrove forest, Bangladesh were determined using gamma-ray spectrometry to assess temporal variation of the radionuclides in the Sundarban. To obtain the depth-wise variation of the

natural radioactivity, core samples were cut into a 2 cm slice and analyzed. The average activity concentrations of ^{226}Ra , ^{232}Th , and ^{40}K in the first core were found to be $46.9 \pm 8.0 \text{ Bq kg}^{-1}$, $61.6 \pm 10.3 \text{ Bq kg}^{-1}$, and $2110 \pm 44.8 \text{ Bq kg}^{-1}$, in the second core $73.4 \pm 10.2 \text{ Bq kg}^{-1}$, $91.2 \pm 11.6 \text{ Bq kg}^{-1}$ and $2120 \pm 44 \text{ Bq kg}^{-1}$, in third core $81.2 \pm 7.6 \text{ Bq kg}^{-1}$, $82.8 \pm 5.2 \text{ Bq kg}^{-1}$ and $9770 \pm 139 \text{ Bq kg}^{-1}$, and fourth core $33.8 \pm 6.8 \text{ Bq kg}^{-1}$, $87.1 \pm 5.0 \text{ Bq kg}^{-1}$ and $1880 \pm 123 \text{ Bq kg}^{-1}$, respectively. The average activity concentrations of ^{226}Ra , ^{232}Th , and ^{40}K in Bangladeshi Sundarbans are elevated when compared with Indian Sundarban as well as the world average. The results of this study could serve as important radiometric data and variation of radioactivity levels in the Sundarban with time.

1.2 Provenance, Weathering, Climate and Tectonic Setting of Padma River Sediments, Bangladesh: A Geochemical Approach

R. Khan, K. Naher, M. A. Islam, U. Tamim, M. A. Azam, I. Khalil, M. S. Islam, A. Ullah and M. S. Uddin

The major, trace, and rare earth element (REE) compositions of sediments from the Padma River, Bangladesh have been examined using XRF and INAA analysis to determine their geochemical compositions, provenance, climate, weathering intensity and tectonic setting. The Padma River sediments from the region were remarkably comparable, demonstrating elemental depletion and pointing to a low geochemical maturation. Sediment samples are classified as arkose which are considered as chemically immature sediments, deposited under semi-arid to semi-humid climatic conditions due to the weakening of Indian summer monsoon. The low CIA values (48.6 to 58.8), PIA (48.1 to 63.4) and Rb/Sr ratios of the river sediments suggest low intensity of chemical weathering in the source area. The Padma River is originated from the Higher Himalaya and the sediments derived from metasediments (Higher Himalayan Crystalline Series) as are evident by major, trace elements discriminate diagram and REE pattern. Most of the sand samples were derived from felsic source rock (granite) whereas some samples are plotted in the intermediate rock types (granodiorite) in the A-CN-K-FM and discriminant function diagrams. High LREE enrichment and relatively flat HREE fractionation in chondrite-normalized REE patterns ($\text{LaN/YbN} = 7.50$ to 13.20) demonstrated felsic source origin. TiO_2 versus Zr plot shows that Padma River sediments have felsic to intermediate provenance. According to $\text{Log}(\text{K}_2\text{O}/\text{Na}_2\text{O})$ vs. SiO_2 discriminant diagram and La–Th–Sc, Th–Sc–Zr/10 ternary plot, the Padma River sediments were deposited in passive continental margin. The Padma River sediments have been compared with Yarlung Zangbo River (YZR), Brahmaputra-Jamuna River (BJR), Ganges River (GR) and Upper Meghna River (UMR), which results suggest that there is contrast among the sediments of different Himalayan Rivers in relation to provenance, weathering intensity and tectonic setting.

1.3 Geochemistry of Sandstones-Mudstones Suites of Carboniferous-Permian Gondwana Group, Dighipara Basin, Bangladesh: Implication for Provenance, Weathering, Tectonic Setting, and Climate Change

R. Khan, K. Naher, M. A. Islam, U. Tamim, M. A. Azam, I. Khalil, M. S. Islam, Aman Ullah and M. S. Uddin

The present study is aimed to Gondwana sediments, collected from GDH-61/04 drillhole of Dighipara, Dinajpur, Bangladesh to evaluate their provenance, tectonic setting, weathering conditions, and paleoclimatic reconstruction with comparison of adjacent Gondwana deposits of Bangladesh and India. Petrographic thin sections reflect a higher presence of Quartz grain with few feldspars and heavy minerals which indicates long transportation and intense weathering of the sediments. The geochemical data from XRF shows moderate to high SiO_2 contents (79.58-40.24%; on average 61.81%) with a significant amount of Al_2O_3 (41.1- 15.9%; on average 27.8%). The high clay content reflects the loss of labile elements in the source area. The sample TG-15 shows 39.87% of Fe_2O_3 . The Chemical Index of Alteration (CIA) of the samples from GDH 61/04 are showing intense values ranging from 85.71 to 99.43 with an average of 96.65, which reflects an extensive weathering corresponding to a hot and wet climate. The CIA, ICV, CIW, PIA, and $\text{SiO}_2/\text{Al}_2\text{O}_3$ ratio reflect intense chemical weathering corresponding to a hot and humid climate with a relatively high degree of recycling and moderate maturity of the sediments and derived from a weathered source. Dept. of Geology and Mining, University of Barishal ii area. Major element and trace element discrimination diagrams ($\text{Al}_2\text{O}_3/\text{TiO}_2$ vs SiO_2 , TiO_2 vs Zr, Th/U-Th and La/Th vs Hf diagram) indicate that most of the samples were derived from the intermediate source rock. Few samples were derived from Mafic (basaltic) sources due to the enrichment of Fe_2O_3 and felsic source rocks due to the enrichment of SiO_2 . The Th/Sc vs Zr/Sc diagram reflects compositional maturity of the Gondwana samples of Dighipara basin. The bivariate diagrams ($\text{SiO}_2/\text{Al}_2\text{O}_3$ - $\text{K}_2\text{O}/\text{Na}_2\text{O}$, Th-Sc-Zr/10, and La-ThSc) suggest that the Permo-carboniferous Gondwana sequence of the

Dighipara basin lay mostly in a passive margin setting along with few samples in Active Continental Margin (ACM). The (Ga/Rb and K₂O/Al₂O₃) diagram is reflecting that most of the Gondwana samples were deposited in hot and humid climatic conditions. However, one sample shows cool and arid climatic conditions. Probably the sample was reworked from the bottom part of the succession. The systematic changes of petrographic and geochemical proxies in Dighipara sediments contemplate a weathered source area, had long transportation, and correspond to a hot and humid climate and the sediments were derived from intermediate source rock composition with few derived from mafic source.

Neutron Radiography

1.4 Preparation and Study of Borated Polymerized Wax as a Neutron Shielding Material to be Used for Thermal Neutron Beam Collimation

S. Saha and S. Islam

It is necessary to filter the high neutron flux and gamma and scattered neutron contamination present in thermal neutron beams that are produced by nuclear reactors. Shielding materials for gamma and neutron radiation must be included in a collimator. High density polyethylene, paraffin wax, and boric acid powder are all inexpensive, readily accessible components that may be used to create an efficient neutron shielding material. In the current experiment, multiple ratios (1: 1: 1 and 2: 3: 3) of paraffin wax, high density polyethylene, and boric acid powder are combined to see which one best serves the intended function. A methodical process was used to choose a sample from each combination, which was then sliced and polished. Based on the presence of ¹⁰B there, the likely thermal neutron absorption cross-section was assessed. In addition, the quest for a neutron shielding material with a uniform distribution of its component parts for beam collimation will continue using neutron imaging technique.

Neutron Scattering

1.5 Preparation and Structural Analysis of SrZr_{0.5}Y_{0.5-x}Ca_xO₃ Perovskite for Solid Oxide Fuel Cell

M. S. Islam, S. Hossain, J. Maudood, M. S. Aktar, A. Hye and F. Ahmed

By using the traditional solid-state approach, a number of calcium-doped SrZr_{0.5}Y_{0.5-x}Ca_xO₃ powders (where x=0.0, 0.1, 0.2, 0.3, and 0.4) were synthesized. All of the samples are sintered in an air atmosphere for 8 hours at 1200 °C. The material crystallized in orthorhombic form, according to XRD data. Peak shifting and minor variations in lattice parameters are seen as the doping concentration is changed. The average grain sizes of the samples have increased dramatically as a result of the doping of calcium concentration, according to scanning electron microscopy (SEM).

2. Repair, Maintenance and Renovation work(s)

The repair, maintenance and renovation works for the thermal neutron beam collimator at the tangential beam port of 3 MW TRIGA Mark II research reactor have been started. The rusting due to unexpected extra moisture was cleaned and studied to identify the probable risks and hazards.

3. Seminar/Symposium/Conference/Workshop/Meeting Attended

Name of the participant	Title of the event	Organizer	Date	Place
Dr. Kamrun Naher	Training workshop on Neutron Activation Analysis: Quality Assurance and Quality Control in Proficiency Testing	IAEA and Delft, Netherlands	22-26 August, 2022	Delft, Netherlands
Dr. Kamrun Naher	FY 2022 FNCA hybrid workshop on Research reactor utilization project	MEXT and NSRA, Japan	22-24 November, 2022	Mito, Japan
Dr. Mohammad Amirul Islam	Advanced Instructor Training Course (Reactor Engineering)-2022	MEXT and JAEA, Japan	20-30 September, 2022	Tokai-mura, JAEA, Japan
Dr. Mohammad Amirul Islam	BCSIR Chemical Congress-2022	ANSTO, Australia	1-3 December, 2022	BCSIR, Dhaka, Bangladesh

Name of the participant	Title of the event	Organizer	Date	Place
Dr. Mohammad Amirul Islam	4th International Conference on Energy and Power (ICEP)-2022	Australian Society of Energy and Power and Military Institute of Science and Technology (MIST), Dhaka, Bangladesh	11-13 December 2022	Military Institute of Science and Technology (MIST), Dhaka, Bangladesh
Dr. Mohammad Amirul Islam	International Conference on Environmental Protection for Sustainable Development (ICEPSD-2022)	Forest and Environment Affairs sub-committee of Bangladesh Awami League, University of Dhaka, Bangladesh	2-4 November, 2022	University of Dhaka, Bangladesh
Umma Tamim	MEXT Nuclear Researchers Exchange Program-FNCA Research Course	MEXT and Nuclear Safety Research Association (NSRA), Japan	17 October-7 December, 2022	MALT, the University of Tokyo, Japan
Dr. Sudipta Saha	The 4 th Materials Research Society of Thailand International Conference (MRS-Thailand 2023)	American Ceramic Society, Thailand Chapter	28 February – 4 March, 2023	Ubon Ratchathani, Thailand (Online)
Dr. Mohammad Amirul Islam, Dr. Sudipta Saha, Jobair Maudood, Md. Saiful Islam	National Conference on Physics 2023	Bangladesh Physical Society	9-11 March, 2023	Jahangirnagar University, Savar, Dhaka
Jobair Maudood	Follow-up Training Course on Reactor Engendering	BAEC & JAEA	12 Feb. – 02 March, 2023	TI, Savar, Dhaka
Md. Saiful Islam	Follow-up Training Course on Nuclear and Radiological Emergency Preparedness	BAEC & JAEA	04-15 December 2022	TI, Savar, Dhaka
Md. Saiful Islam	Workshop on E-Governance & Innovation	BAEC	28 November 2022	BAEC HQ

4. Collaboration Work/MoU

RNPD has collaboration with

1. Sunway University, Malaysia
2. Indian Institute of Technology, Kharagpur, India
3. Prince of Songkla University, Thailand
4. Suez Canal University, Egypt
5. University of Brunei Darussalam, Brunei Darussalam
6. University of St. Andrews, UK
7. Kyungpook National University, South Korea
8. Nakhon Pathom Rajabhat University, Thailand
9. University of Dhaka, Bangladesh
10. Military Institute of Science and Technology, Bangladesh
11. Atomic Energy Centre, Dhaka (AECD)

NAA group of RNPd actively participate in two FNCA projects.

- Research Reactor Utilization/NAA
- Climate Change Science Research using Nuclear and Isotopic Techniques

INSTITUTE OF ELECTRONICS (IE), AERE

General Electronics Division

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.

Activities

1. Research and Development Work(s)

1.1 Microcontroller based Portable Radiation Dose Rate Meter (MDGE)

Microcontroller-based Radiation Dose Rate Meter (MDGE) has been designed and developed with analog display and working satisfactorily in several institutes. The improvement and digitalization work of this meter is going on collaboration with NED lab.

1.2 Microcontroller based Hand Foot and Cloth Contamination Monitor (HFRM): In order to improve the nuclear safety features of the existing Hand and Foot Radiation Monitor, the Microcontroller-Based Hand Foot and Cloth Contamination Monitor has been designed and fabricated and working satisfactorily. Development work 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 radiation safety of the personnel. Design and Development of microcontroller based digital ARM has been completed in cooperation with Nuclear Electronics Division. After fabrication one ARM has been supplied to BINA, Mymensingh. A new design has been developed and its Working Satisfactorily.

1.4 Design and Development of a Microcontroller Based Light Intensity Control System: It is a customized instrument which is used to control two lights of a room for research purpose. The design of the instrument is going on.

1.5 Design and Development of Laboratory Power Supply:

It is also a customized instrument for Radio Isotope and Production Division (RIPD). This division has a Laboratory-scale. To operate with this Laboratory-scale a Power Supply has been designed and developed by this division. The instrument is working satisfactorily.

1.6 Design and Development of Microcontroller Based Chiller Controller for VLSI Laboratory: Microcontroller Based Chiller Controller has been designed for VLSI Laboratory and working satisfactorily.

1.7 Software Development

1.8 Development of Microcontroller Based Instruments: The software development of Microcontroller Based Instruments is going on.

2. Others

2.1 Production Works

The following Instruments were produced by this time:

Area Radiation Monitoring Meter, Model: ARMIE-04, Serial No: 052201, Beneficiary: Institute of Food and Radiation Biology, AERE, Savar, Dhaka

3. Repair and Maintenance work

The following instruments were repaired by this time:

- Gamma Source Controller Model: GScIE-11, Serial No.: 120802, User: Gamma Source Division, IFRB. AERE, Savar, Date: 25.08.2022

- Portable Radiation Dose Rate Meter, Model: DRGE-31, Serial No.: 070401, User: INM, AERE, Savar, Date: 26.01.2023.
- Survey Meter, Model: LUDLUM 3000, User : KSRM Steel Plant Ltd. Date: 12.04.2023.
- Survey Meter, Model: LUDLUM 3000 Serial No.: 25018055, Manufacturer: USA, User: INMAS Chittagong, Date: 27.04.2023.

4. Lecture Delivered

Scientist and Engineer of this division (collaboration) supervised two weeklong industrial training from 13 November 2022 to 24 November 2022 of third year student of Nuclear Engineering department of University of Dhaka, held at Institute of Electronics, AERE, Savar, Dhaka.

5. Participation in Colloquia, Seminars, Conference, etc.

1. 2022 4th International Conference on Sustainable Technologies for Industry 4.0, 17-18 December 2022 at Dhaka, Bangladesh.
2. International Conference on Machine Intelligence and Emerging Technologies 2022 (MIET 2022), 23-25 September 2022 at Noakhali Science and Technology University, Noakhali, Bangladesh.
3. Scientist and Engineer of this division participated in the seminar on “Scanning Electronic Microscope (SEM) Scope” speaker, Mr. Nitin Jade, Service Manager, TESCAN on 30 November 2021 held at Institute of Electronics, AERE, Savar, Dhaka. Installation of Scanning Electronic Microscope has completed during the period 21 to 30 November and 24 April 2022.
4. Scientist and Engineer of this division participated in the seminar on “Solar Cell Laser Cutter Scopes” speaker, SuneelkumarMalkai, Service Manager, Coherent Laser India Pvt. Ltd. on 24 August 2022 held at Institute of Electronics, AERE, Savar, Dhaka. Installation of Laser Cutter has completed during the period 22 to 25 August 2022.
5. Scientist and Engineer of this division participated in the seminar on “Installation & Operational Training of Nuclear Lab Kit Basic & Advanced With Accessories” speaker, N. Rama Krishna, Development Manager and AdityMandava Application Engineer & Radiation Safety Officer, Advancetech Controls PVT. LTD, Maharastra, India, on 21 December 2022 held at Institute of Electronics, AERE, Savar, Dhaka. Installation of Nuclear Lab kit Basic & Advance with Accessories has completed during the period 11 to 21 December 2022.

6. Workshop/Training Program

Md. Ziaul Hasan Majumder S.O. of this division delivered lectures at “Workshop on PCB designing (Easy PC, Proteus) and prototyping (ProtoMat S64)” on 05 March 2023 which held at Institute of Electronics, AERE, Savar, Dhaka.

6. Manpower Development

Md. Ziaul Hasan Majumder S.O. participated in a training course on “E-Governance & Innovation” on 28 November 2022, organized by Bangladesh Atomic Energy Commission at Head Office, Dhaka.

Nuclear Electronics Division, IE

Program(s)

1. Design, development and fabrication of nuclear instruments for laboratory use.
2. Refurbishment of nuclear instruments.
3. Repair, maintenance and installation of nuclear and non-nuclear equipment.
4. Academic program: Supervise/Guide thesis work.
5. Human resource development and training program.

Activities

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 BRIT 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. A step has been taken to develop a control console that will control and displays Irradiation time of the Co-60 source along with Compressor ON time. Development work is going on.

1.3 Design and Development of Ultrasonic Humidity Controller:

In our country some research laboratories, scientific stores, medical places, insect rearing room etc. need a stable temperature and humidity for the proper functioning of their classified instruments or storage of food, medicine, growing of insects, plants etc. To maintain suitable temperature air conditioners are used but this air conditioners action reduces the humidity of the room. As a result this humidity reduction hinders the purpose of the confined room and there need to take some measures to increase the humidity. This Ultrasonic Humidity Control System (UHCS) is designed to handle these delicate issues. The system is designed using a fast ,powerful intelligent microcontroller and an Ultrasonic transducer for humidification. The instrument controls and monitors the humidity of the laboratory. 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 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.

1.8 Design and Development of a PIC Microcontroller-based System for Dose Rate Measurement Using Geiger–Mueller Counter:

Gamma events and dose rate calculation are very crucial in our everyday life to secure us from radiation and radioactive elements. In this paper, a dosimeter is developed for assessing dose rate, which is highly cost-effective as well as measures background radiation to a maximum of 5 mSv/h precisely. A peripheral interface controller (PIC) has been used as the main controlling unit of the instrument. To detect the gamma events a highly sensitive Geiger Muller (GM Tube) is used which is activated by a high voltage source. The output pulse of the GM tube is normalized using a transistor and then fed into the PIC. The number of GM tube pulses per second is counted by PIC and filtered by a modified Savitzky-Golay(S-G) filter. Afterward, the PIC converts the counts to dose rate by using an empirical equation that is developed in this research work. The measured dose rate is then displayed on a liquid crystal display (LCD) and the radiation worker is warned through a chirping rate of the buzzer attached to the system. The designed system is driven by a Li-ion cell and 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.

2. Software Development

Development of Microcontroller Based Instruments:

The Software Development of Microcontroller Based Instruments is going on.

3. Lecture Delivered

1. Scientist and Engineer of this division (collaboration) supervised two weeklong industrial training from 13 November 2022 to 24 November 2022 of third year student of Nuclear Engineering department of University of Dhaka, held at Institute of Electronics, AERE, Savar, Dhaka.
2. Md. Motinur Rahman of this division delivered lectures at “Workshop on PCB designing (Easy PC, Proteus) and prototyping (ProtoMat S64)” on 05 March 2023 and “Training on PCB prototyping (ProtoMat S64)” on 07 March 2023, which held at Institute of Electronics, AERE, Savar, Dhaka.

4 Participation in Conference/Seminar

- Md. Motinur Rahman & M. Khalid Hossain “Energy System in Smart Grid System using CVR Technique” at online “Second International e-Conference on Chemicals & Materials for Emergent technologies (CHEMET-2022)” jointly organized by Center for Advanced Materials-Qatar University, Emergent Materials Journal & ChemistryAfrica Journal-Springer on 17 – 18 October 2022, PP – 05, CHMET-II.
- Scientist and Engineer of this division participated in the seminar on “Scanning Electronic Microscope (SEM) Scope” speaker, Mr. Nitin Jade, Service Manager, TESCAN on 30 November 2021 held at Institute of Electronics, AERE, Savar, Dhaka. Installation of Scanning Electronic Microscope has completed during the period 21 to 30 November and 24 April 2022.
- Scientist and Engineer of this division participated in the seminar on “Solar Cell Laser Cutter Scopes” speaker, Suneelkumar Malkai, Service Manager, Coherent Laser India Pvt. Ltd. on 24 August 2022 held at Institute of Electronics, AERE, Savar, Dhaka. Installation of Laser Cutter has completed during the period 22 to 25 August 2022.
- Scientist and Engineer of this division participated in the seminar on “Installation & Operational Training of Nuclear Lab Kit Basic & Advanced With Accessories” speaker, N. Rama Krishna, Development Manager and Adity Mandava Application Engineer & Radiation Safety Officer, Advancetech Controls PVT. LTD, Maharastra, India, on 21 December 2022 held at Institute of Electronics, AERE, Savar, Dhaka. Installation of Nuclear Lab kit Basic & Advance with Accessories has completed during the period 11 to 21 December 2022.

5. Sample Test by SEM (Scanning Electron Microscope)

Following samples were tested by this time:

01.	09/06/2022	EDS+SEM	06	AECD
02.	20/06/22-27/06/22	Cu+C	11	INST
03.	08/08/2022	Unknown	07	INST
04.	11/08/2022	Unknown	10	INST
05.	31/08/2022	Unknown	10	INST
06.	08/09/2022	Unknown	2	INST
07.	14/09/2022	Unknown	2	IE
08.	28/09/2022	Unknown	6	IRPT
09.	08/10/2022	Unknown	8	IFRB
10.	31/10/2022	Unknown	5	IE
11.	01/11/2022	Unknown	9	IE
12.	02/11/2022	Unknown	9	IE
13.	03/11/2022	Unknown	4	IE

14.	06/11/2022	Unknown	5	IE
15.	07/11/2022	Unknown	5	IE
16.	14/11/2022	Unknown	7	IE
17.	15/11/2022	Unknown	6	IRPT
18.	16/11/2022	Unknown	3	IE
19.	17/11/2022	Unknown	4	IFRB
20.	20/11/2022	Unknown	2	IE
21.	24/11/2022	Unknown	1	IRPT
22.	06/12/2022	Unknown	1	INST
23.	07/12/2022	Unknown	9	INST
24.	04/01/2023	CuFe2O4	06	IE
25.	11/01/2023	Unknown	08	IE
26.	15/01/2023	Unknown	03	IE
27.	22/01/2023	Unknown	04	INST
28.	01/02/2023	CoU	10	IE
29.	02/02/2023	Unknown	13	IE
30.	05/02/2023	Unknown	03	INST
31.	07/02/2023	Unknown	06	IE
32.	12/02/2023	Unknown	06	IE
33.	01/03/2023	MnO2	02	IE
34.	07/03/2023	Unknown	03	IRPT
35.	03/04/2023	Unknown	04	CEF
36.	09/04/2023	Unknown	03	IRPT
37.	24/05/2023	TiO2	07	IE
38.	04/06/2023	Unknown	06	INST
39.	06/06/2023	Unknown	09	IRPT
		Total	225	

Following Instruments also installed in the Institute & Electronics During this period:

1. PCB Fabrication System
2. Hall Effect Measurement System
3. Four Point Probe Complete Set
4. Gas Leak Detector
5. Nim Bin and Accessories
6. Oscilloscopes (MSO)
7. PC Based Oscilloscope
8. Semiconductor Parameter Analyzer
9. Impedance Analyzer
10. Wave Analyzer
11. Spectrum Analyzer
12. Audio Video System

6. ADP Project

Fahmida Akter, Chief Engineer of this division, working as a project Director of the following ADP Project “Improvement and modernization of the laboratory facilities of Institute of Electronics”.

Robotics Instrumentation and Control Division (RICD), IE

Objective

- i. Robotics
- ii. Instrumentation using Metamaterials
- iii. Design and Development of Control Systems

Activities

1. Research and Development Work(s)

M.K. Hossain *et al.*, Combined DFT, SCAPS-1D, and wxAMPS frameworks for design optimization of efficient $\text{Cs}_2\text{BiAgI}_6$ -based perovskite solar cells with different charge transport layers, RSC Adv. 12 (2022) 34850–34873. <https://doi.org/10.1039/D2RA06734J>.

Description :

In this study, combined DFT, SCAPS-1D, and wxAMPS frameworks are used to investigate the optimized designs of $\text{Cs}_2\text{BiAgI}_6$ double perovskite-based solar cells. First-principles calculations are employed to investigate the structural stability, optical responses, and electronic contribution of the constituent elements in $\text{Cs}_2\text{BiAgI}_6$ absorber material, where SCAPS-1D and wxAMPS simulators are used to scrutinize different configurations of $\text{Cs}_2\text{BiAgI}_6$ solar cells. Here, PCBM, ZnO , TiO_2 , C_{60} , IGZO, SnO_2 , WS_2 , and CeO_2 are used as ETL, and Cu_2O , CuSCN , CuSbS_2 , NiO , P3HT, PEDOT:PSS, spiro-MeOTAD, CuI , CuO , V_2O_5 , CBTS, CFTS are used as HTL, and Au is used as a back contact. About ninety-six combinations of $\text{Cs}_2\text{BiAgI}_6$ -based solar cell structures are investigated, in which eight sets of solar cell structures are identified as the most efficient structures. Besides, holistic investigation on the effect of different factors such as the thickness of different layers, series and shunt resistances, temperature, capacitance, Mott–Schottky and generation–recombination rates, and J – V (current–voltage density) and QE (quantum efficiency) characteristics is performed. The results show CBTS as the best HTL for $\text{Cs}_2\text{BiAgI}_6$ with all eight ETLs used in this work, resulting in a power conversion efficiency (PCE) of 19.99%, 21.55%, 21.59%, 17.47%, 20.42%, 21.52%, 14.44%, 21.43% with PCBM, TiO_2 , ZnO , C_{60} , IGZO, SnO_2 , CeO_2 , WS_2 , respectively. The proposed strategy may pave the way for further design optimization of lead-free double perovskite solar cells.

2. Repair& Maintenance, Renovation works, etc : Workstation (Lenovo ThinkStation, P330).

3. Design and Development

- Design and Development of and Fabrication of AC change-over switch (2 Pieces)
- Design and Development and fabrication of Automatic Time Controlled Switch (1 Piece)

4. Manpower Development

Seminar Titled “Presentation for introducing Acoustic Metamaterials and Conducted Research Works and Its Scope for Practical Applicability.” Has been presented by Dr. Anzan-Uz-Zaman, PSO. Dated 15 June 2023, at Auditorium, IE

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.

Activities**1. Repair, Maintenance and Renovation Work(s):**

Sl. No.	Name & description of the instruments	Intender
01	Laser Printer, Model: LBP 3300, Serial No: LQHA642596, Manufacturer: Canon, Country of Origin: China, Approximate Price of the Instrument: 25,000/- (Twenty five Thousand Taka Only)	RPED, INST, AERE
02	Laser Printer, Model:P1102, Serial No: VNF8407011, Manufacturer: HP, Country of Origin: Vietnam, Approximate Price of the Instrument: 20,000/- (Twenty Thousand Taka Only)	CAD, AERE
03	Kettle, Model: 1.8L/1800W, Serial No: 2217, Manufacturer: Kiam, Country of Origin: India, Approximate Price of the Instrument: 2,000/- (Two Thousand Taka Only)	Solar Cell, IE, AERE
04	UPS & AVR, Model: UVL-2000, Serial No: MICRO 121/11, Manufacturer: Micro, Country of Origin: Bangladesh, Approximate Price of the Instrument: 40,000/- (Forty Thousand Taka Only)	NRCD, INST, AERE
05	Multimedia Projector, Model: CP-DX301, Serial No: QC6HE03012, Manufacturer: Hitachi Japan, Country of Origin: China, Approximate Price of the Instrument: 60,000/- (Sixty Thousand Taka Only)	SIU, AERE
06	HP Laser Jet P1102, Model: P1102, Serial No:VNC4313281, Manufacturer: HP11311 Ohinde USA , Country of Origin: Vietnam, Approximate Price of the Instrument: 20,000/- (Twenty Thousand Taka Only)	GSD, IFRB, AERE
07	Laser Printer Jet, Model: HP Laser Jet P1102, Serial No:VNF3R58742, Manufacturer: HP USA, Country of Origin: Vietnam , Approximate Price of the Instrument: 20,000/- (Two Thousand Taka Only)	CF & AD, AERE
08	HITACHI Multimedia Projector, Model: CP-X3041WN, Serial No: F5JH03797, Country of Origin: Japan, Approximate Price of the Instrument: 80,000/- (Eighty Thousand Taka Only)	DG Office, AERE
09	Laser Printer Jet, Model: LBP 3300, Serial No:LQHA648040, Manufacturer: Canon, Country of Origin: China , Approximate Price of the Instrument: 25,000/- (Twenty five Thousand Taka Only)	IRPT, AERE
10	Hand Held Metal Detector, Model:3003B1, Serial No:033868, Manufacturer: Super Scanner, Country of Origin: China , Approximate Price of the Instrument: 2,000/- (Two Thousand Taka Only)	Security Branch, AERE
11	Desktop Computer, Model: Delux, Serial No:GA-H110M-DS2, Manufacturer: Gigabyte, Country of Origin: China , Approximate Price of the Instrument: 40,000/- (Forty Thousand Taka Only)	Administration IRPT, AERE
12	Conductivity Meter, Model: Senso Direct Con200, Serial No:03041199, Manufacturer: Lobibond, Country of Origin: Germany , Approximate Price of the Instrument: 1,00,000/- (One Lac Taka Only)	CRR, AERE
13	Water Still, Model:W4000, Serial No:M18761, Manufacturer:Bibby Scientific, Country of Origin: UK , Approximate Price of the Instrument: 1,50,000/- (One Lac Fifty Thound Taka Only)	Gamma Source Division, IFRB, AERE
14	Computer, Model: N/A, Serial No:N/A, Manufacturer: Gigabyte, Country of Origin: China , Approximate Price of the Instrument: 40,000/- (Forty Thousand Taka Only)	IRPT, AERE
15	Distil Water Plant, Model: WSE/45, Serial No:9840, Manufacturer: Hamilton Lab.Ltd, Country of Origin: UK , Approximate Price of the Instrument: 2,00,000/- (Two Lac Taka Only)	IBD, IFRB, AERE
16	Sutter of Neutron, Model: N/A, Serial No: N/A, Manufacturer: Scattering, Country of Origin: N/A , Approximate Price of the Instrument: 15,00,00,000/- (Fifteen Crore Taka Only)	RNPD, INST, AERE

Very large Scale Integration (VLSI) technology division, IE

Objective

The Bangladesh Atomic Energy Commission developed the VLSI (Very Large Scale Integration) Laboratory in 2012 to advance cutting-edge semiconductor 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. In reality, the VLSI Laboratory opens a new horizon in microelectronics and semiconductor research for the first time in Bangladesh.

Activities

1. Research and Development Work(s)

- 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 MoO₃ nanoparticle and thin films.

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.

Activities

1. Production Work(s)

The following electronic instruments have been produced:

1.1 Production of Digital pH Meter: Quantity - 01

Specifications:

Measuring range: 0-14 pH, Resolution: 0.01 pH, Input Impedance: 10¹² Ohms, Accuracy: ± 0.01 pH, Type of pH electrode: Combination type, Temperature compensation: Manual, Input Base current: 10Pico 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 - 02

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 (Approx.).

2. Repair & Maintenance, Renovation work

The following electronic instruments have been repaired:

- Repair of A.C. Voltage Stabilizer: Quantity – 01
- Repair of Drop-Out-Relay: Quantity – 04

INSTITUTE OF COMPUTER SCIENCE (ICS), AERE

The Institute of Computer Science (ICS) was established in December 1981 at the Atomic Energy Research Institute, Savar. The main objective of the institute is to provide research, development, training and consultancy. The country's first computer IBM-1620 was installed in the computer department of Atomic Energy Center in Dhaka in 1964. This IBM computer is well known for providing training and data processing

services to scientists and researchers of BAEC and other institutes. Later in 1983 another mainframe computer IBM-4341 was installed at the Institute of Computer Science. It was used for training, data processing and research by various government agencies and scientists for another decade.

Due to the promotion and spread of information technology in the last decade, information technology has touched all fields including science. As a result, information technology has achieved a radical change in Bangladesh besides contributing to the socio-economic development of the country. In line with this, ICS is providing science-based research and services by coordinating nuclear science and technology and ICT for the peaceful 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, ICS

Objective

Computer System and Network Division is mainly responsible for designing, 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 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. Research and Development Work(s)

1.1 A Machine Learning (ML) approach to predict the prodome step of Migraine by analyzing the trigger incidents.

Md. Mahbub Alam, 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 prodome step of migraine by analyzing different trigger incidents using machine learning algorithms.

Keywords: Migraine, Machine Learning, Classification, Prediction, Trigger Incidents, Headache.

1.2 Optical Fiber Network Route Planning, Design and Deployment for Atomic Energy Research Establishment.

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.

Keywords: Network Design; Optical Fiber; Planning & Deployment; Route Planning

1.3 Implementation of Local Area Network (LAN) & Build a Secure LAN System for BAEC Head Quarter.

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 computer 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 define is Data com 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 of the Local Area Network set up for a BAEC HQ and build a secure LAN system.

Keywords: LAN, Secure LAN, BTCL, UTP, RJ-45, Bandwidth, Wavelength, ISP, Firewall, BAEC

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 peta bit × 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.

Keywords: Optical Fiber, Route Planning, Deployment, Network Design, BTCL, AECDC, Frequency band, Wavelength.

1.5 Implementation of Local Area Network in Thyroid Disease Management at INMAS, Dhaka.

Md. Abu Shameem, Osman Goni, 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.

Keywords: LAN, Information, Digital Technology, BAEC, INMAS, Thyroid Disease, Digitalized.

2. Seminar/Symposium/Conference/Workshop/Meeting Attended

- i. Integrated Digital Service Delivery Platform User Acceptance Test dated : 8-14 May, 2023. Attended by Md. Mahbub Alam, Scientific Officer, CSND, ICS.
- ii. Meeting about National Single Window to modernize Import/Export facilities of Bangladesh. Dated : 08 January, 2023. Attended by Md. Mahbub Alam, Scientific Officer, CSND, ICS

3. Service Rendered

Assemble, Troubleshooting, Repair and Maintenance of PC:

A number of new computers have been assembled for ICS as well as other Institute of BAEC. Beside this, 51 computers have been repaired and upgraded during this period. A list of these activities for the period of July 2021 to June 2022 is given below:

Sl. No.	Name of the institute	No. of PC
1.	Institute of Nuclear Science and Technology (INST), Savar	08
2.	Institute of Food and Radiation Biology (IFRB), Savar	07
3.	Institute of Computer Science (ICS), Savar	10
4.	Nuclear Mineral Unit (NMU), Savar	08
5.	Central Administrative Division (CAD), Savar	09
6.	Central Finance & Accounts Division (CF&AD), Savar	04
7.	Scientific Information Unit (SIU), Savar	02
8.	Institute of Radiation & Polymer Technology (IRPT), Savar	04
9.	Training Institute , (TI)Savar	04
10.	Central Engineering Facility (CEF), Savar	05

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 2022 to June 2023 more than 370 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	25
2.	Institute of Food and Radiation Biology (IFRB) ,Savar	22
3.	Institute of Electronics (IE) ,Savar	08
4.	Institute of Computer Science (ICS) ,Savar	04
5.	Central Engineering Facility (CEF) ,Savar	08
6.	Institute of Nuclear Mineral (INM) ,Savar	04
7.	Central Administrative Division (CAD) ,Savar	12
8.	Central Finance & Accounts Division (CF&AD) ,Savar	09
9.	Institute of Energy Science (IES), AERE, Savar	03
10.	Institute of Tissue Banking and Biomaterial Research (TBBR), Savar	08
11.	Center for Research Reactor (CRR) , Savar	07
12.	Scientific Information Unit (SIU) ,Savar	02
13.	Institute of Radiation & Polymer Technology (IRPT) ,Savar	07
14.	Training Institute ,(TI) Savar	02
15.	Medical Physics	12
16.	Daily Basis Employee, AERE,Savar	10
17.	Visitor Pass, AERE, Savar	100
18.	BAEC Head Quarter, Dhaka	10
19.	Atomic Energy Center, Dhaka	55
20.	Institute of Nuclear Medicine & Ailed Sciences (INMAS), Rajshahi	09
21.	National Institute of Nuclear Medicine & Ailed Sciences(NINMAS),Shahbag , Dhaka	32
22.	National Institute of Nuclear Medicine & Ailed Sciences (NINMAS), Dhaka	17

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 2022 to June 2023 is given below:

Sl. No.	Name of the institute	No. of card
1.	Institute of Nuclear Science and Technology (INST),Savar	95
2.	Institute of Food and Radiation Biology (IFRB) ,Savar	78
3.	Institute of Electronics (IE) ,Savar	29
4.	Institute of Computer Science (ICS) ,Savar	27
5.	Central Engineering Facility (CEF) ,Savar	17
6.	Institute of Nuclears (INM), Savar	19
7.	Central Administrative Division (CAD) , Savar	75
8.	Institute of Energy Science (IES), AERE, Savar	19
9.	Institute of Tissue Banking and Biomaterial Research (ITBBR),Savar	17
10.	Center for Research Reactor (CRR) ,Savar	10
11.	Scientific Information Unit (SIU) , Savar	07
12.	Training Institute (TI) ,Savar	31
13.	Institute of Radiation & Polymer Technology (IRPT) ,Savar	19
14.	Savar, Quarter	39
15.	BAEC Head Quarter, Dhaka	355
16.	Atomic Energy Center, Dhaka	110

Software Engineering Division, ICS

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. Research and Development Work(s)

1.1 Importance of Artificial Intelligence in the Modern World.

N. K. Datta, M. M. Alam

Artificial Intelligence, or AI, is machine learning intelligence, rather than human intelligence which is a combination of emotion and consciousness. AI's role in our modern day society is to perform tasks which would normally require human intelligence and resources. The difference between humanity and machines is the speed, accuracy and precision, in all, the effectiveness of how certain tasks are performed.

AI can be used in several areas such as research in the nuclear and medical field or creating innovative technology, for instance, autonomous vehicles. Artificial intelligence is used in the medical field to improve the accuracy of programs used for detecting health conditions. AI technology is also used in programs such as Netflix or Spotify. This type of AI will monitor a user's habits and make recommendations based on their recent activity. Banks use AI systems to monitor activity on members' accounts to check for identity theft, approve loans and maintain online security. Chatbot or Chat-robot is an AI-controlled computer program that prompts human conversations. The AI Chatbot works as a virtual help desk in assisting the organization.

Artificial intelligence (AI) is becoming increasingly prevalent in today's world, and its impact on various industries and society as a whole cannot be underestimated. Learning about AI is crucial for several reasons, as outlined below.

Career Opportunities

AI is transforming various industries, and there is a growing demand for professionals who possess AI skills and knowledge. Learning about AI can help individuals to develop in-demand skills that can lead to exciting career opportunities in areas such as data science, machine learning, and robotics.

Understanding Emerging Technologies

AI is an emerging technology that is rapidly evolving. Learning about AI can help individuals to understand the current state of the technology and its potential impact on various industries. This knowledge can help individuals to identify new opportunities for innovation and growth.

Ethical Considerations

As AI becomes more prevalent, it is essential to consider the ethical implications of its use. Learning about AI can help individuals to understand the potential risks and benefits of AI and make informed decisions about its use. It can also help individuals to advocate for ethical AI practices and ensure that AI is used in a responsible and transparent manner.

Improved Problem Solving

AI is often used to solve complex problems that would be challenging or impossible for humans to solve. Learning about AI can help individuals to develop critical thinking and problem-solving skills that can be applied to a wide range of fields.

Improved Decision-Making

AI can help businesses and individuals to make better decisions by analyzing vast amounts of data and identifying patterns and trends. Learning about AI can help individuals to understand how to use AI to improve decision-making and stay competitive in today's fast-paced business environment.

In conclusion, learning about AI is essential in today's world. It can provide individuals with in-demand skills, help them understand emerging technologies, consider ethical implications, improve problem-solving skills, and enhance decision-making abilities. As AI continues to evolve, learning about it will become even more critical to stay competitive in the job market and succeed in various industries.

1.2 Testing and Debugging of Software system.

N. K. Datta, M. M. Alam

A software system is a set of interrelated components assembled to accomplish certain objectives or goal. Basic characteristics of a system are highlighted as boundaries, interfaces, input-outputs, and methods of making outputs from inputs. The environment of a system includes people, organizations, and other systems that supply data to or receive data from the system.

- Testing is a process that confirms a program or system meets all its specifications.
- Debugging is finding and fixing errors in a program or system.

Solving problems comes from a system that usually uses the method of systems approach taking into account the goals, environment, and internal workings of the system. This method involves the following steps:

- i) Define the problem and collect data for the problem.
- ii) Identify and evaluate feasible solutions.
- iii) Select the best solution and determine whether the solution is working.

Alpha test of software is near its development and is internally tested for bugs/issues at the developer site.

Beta test of software is stable and is released to a limited user base and tested at the user site. The goal is to get user feedback on the product and make changes in software accordingly.

Alpha Testing involves both black-box testing as well as white box testing. Beta Testing is always a black box testing or functional testing. Alpha Testing is done before the launch of software product into the organization/market whereas Beta Testing is done at the time of software product releasing/marketing.

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.

2. Others

- Software Development: Management Information System (MIS)
- Software Development: General Provident Fund (GPF)

3. Manpower Development

(Training program/Workshop/ Seminar/Symposium/Conference Arranged)

Sl. No	Title (training program/workshop/seminar/symposium/conference)	Date	Place	No. of participant
1.	চতুর্থ শিল্পবিপ্লবের চ্যালেঞ্জ মোকাবিলায় করণীয় বিষয়ে অবহিতকরণ	07/06/2022	BAEC HQ	25
2	4IR related tools and technology adaptation to conquer its challenges	23/01/2023	BAEC HQ	25

4. Seminar/Symposium/Conference/Workshop/Meeting Attended

Name of the participant	Title of the event	Organizer	Date	Place
Nayan Kumar Datta	4th International Conference on “Physics for Sustainable Development and Technology (ICPSDT-2022)	Department of Physics, CUET, Chattogram, Bangladesh	22-23 January, 2022	Department of Physics, CUET, Chattogram

5. Service Rendered

Sl. No.	Name of the services	Nature of sample/service	Total number/quantity of sample/person/ patient	Income (BDT)
1.	Management and Maintenance Official Web-portal of BAEC	ICT Based Expert Servicers	As per required	None
2.	Contents Uploading at the Official Web-portal.	ICT Based Expert Servicers	About 450	None
3.	Management and Maintenance Directory of Personnel of BAEC.	ICT Based Expert Servicers	About 150	None
4.	Management and Maintenance Foreign Visit Records Web-based software of BAEC.	ICT Based Expert Servicers	About 5	None

Nuclear Cyber Security Division, ICS**Objective**

The major aims and objectives of the Nuclear Cyber Security Division (NCSD) are to conduct basic & applied research on nuclear cyber security, computer network and information security, cyber-physical infrastructure with new 4th industrial technologies, etc. NCSD also provides training in the field of relevant security issues, cyber security building awareness and ICT for the development of human resources at BAEC. NCSD publishes several articles in peer-reviewed journals, and conference proceedings, and participates in relevant international/national seminars and workshops. This division provides ICT services to BAEC as well, such as BAEC domain-based official email services, Management Information System, D-Nothi services, software and web application development, maintenance, and Upgradation of inter-network infrastructure of BAEC through ensuring security at core level network system, manpower development, etc. Nowadays it also meets up with the information and cyber security of the Atomic Energy Research Establishment through the successful implementation of the Firewall services. Establishing a data center is going on under the supervision of NCSD Lab for the data security and digitalization of different activities for the Commission. NCSD has developed Moodle-based e-learning management software as a part of human resources development and nuclear cyber security awareness to the public. NCSD is also serving for the implementation of a secure D- Nothi system at BAEC as an administrator of the D-Nothi system.

Activities

1. Research and Development Work(s)

1.1 Research on BAEC Based Nuclear Cyber Security and Network Security.

M. S. Islam, K. N. S. Mitu, M.A. Uddin, M. D. Hossain

ICS presents the Network Systems such as LAN and Wi-Fi at BAEC HQ, AERE, and AECD through efficient design, development, and implementation. A large number of computers and digital control systems are connected with these networks publicly or privately. Both nuclear cyber security and network security are dynamic fields with new threats and technologies constantly emerging. So, it's a challenging issue to ensure network security for these networks and nuclear cyber security which is concerned with the nuclear-related digital control system. Researchers in Nuclear Cyber Security lab focus on staying ahead of cyber adversaries and continuously enhancing security measures to protect critical infrastructure and sensitive data.

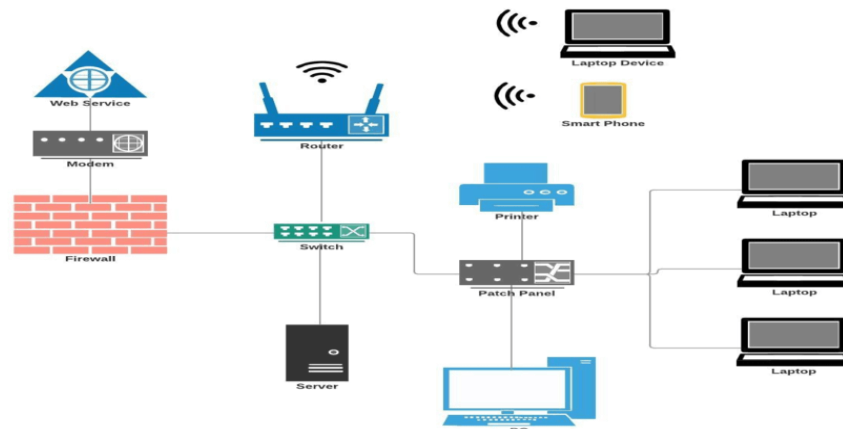


Fig 1. AERE Internal network System.

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.

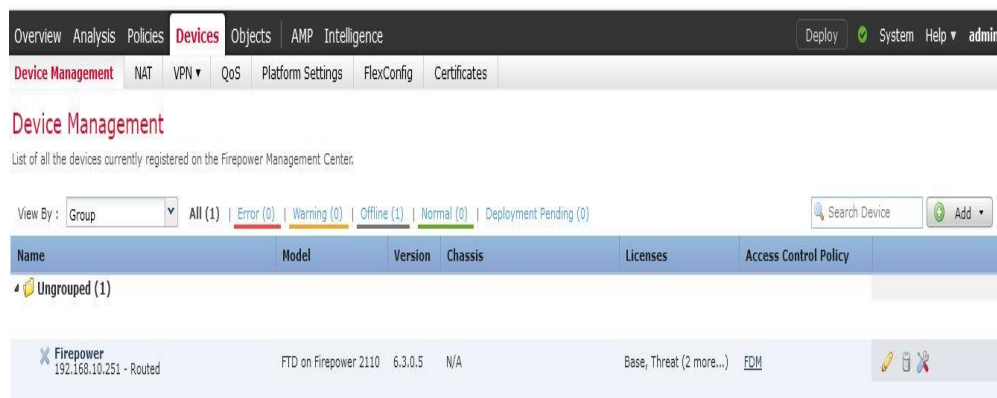


Fig 2. AERE Active Network Monitoring System.

1.2 Expansion of Moodle Based E-learning Management System at BAEC.

M. S. Islam, M. D. Hossain

Bangladesh Atomic Energy commission (BAEC) offers various training and short courses to the employees and students. It includes specialized training courses, Industrial attachment training, different nuclear activity short term or long term courses etc. So in order to make it easier, Moodle based E-learning Management System has been developed at NCSD division of ICS Network Local server. Expanding a Moodle-based e-

learning management system (LMS) at the Bangladesh Atomic Energy Commission (BAEC) involves enhancing its features, functionalities, and content to improve the overall learning experience for students and instructors.

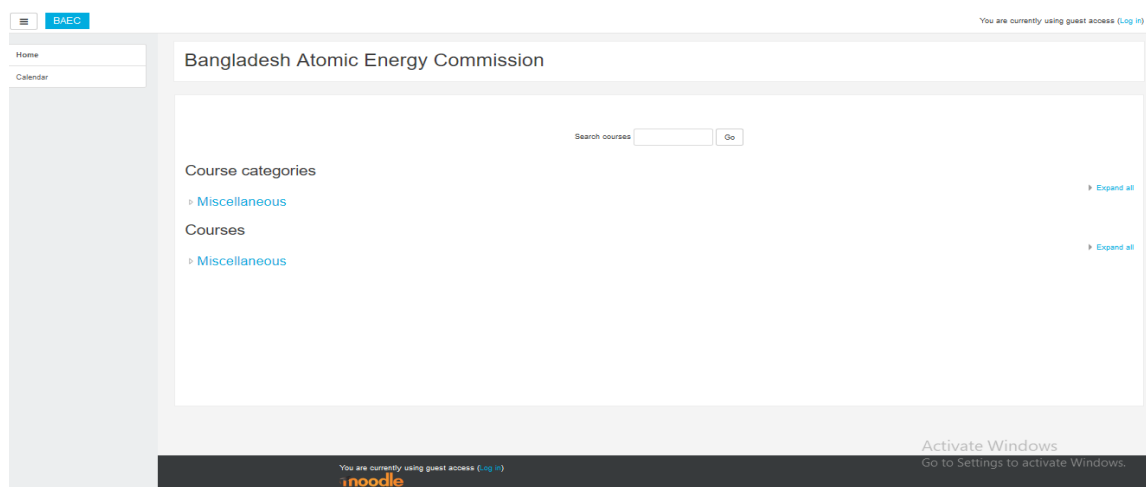


Fig 3. Moodle Based E-Learning Management System at BAEC

1.3 Research on Nuclear Knowledge Management System

M. S. Islam, M. D. Hossain

Bangladesh Atomic Energy commission (BAEC) is a multidisciplinary research organization. Nuclear Knowledge Management (KNM) is one of the paramount research areas of NCSD lab according to the BAEC current demand. A Nuclear Knowledge Management System is a comprehensive approach to capturing, organizing, preserving, and disseminating knowledge within the nuclear industry. It involves the systematic management of knowledge related to nuclear technology, safety, research, operations, and best practices to support decision-making and enhance 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.

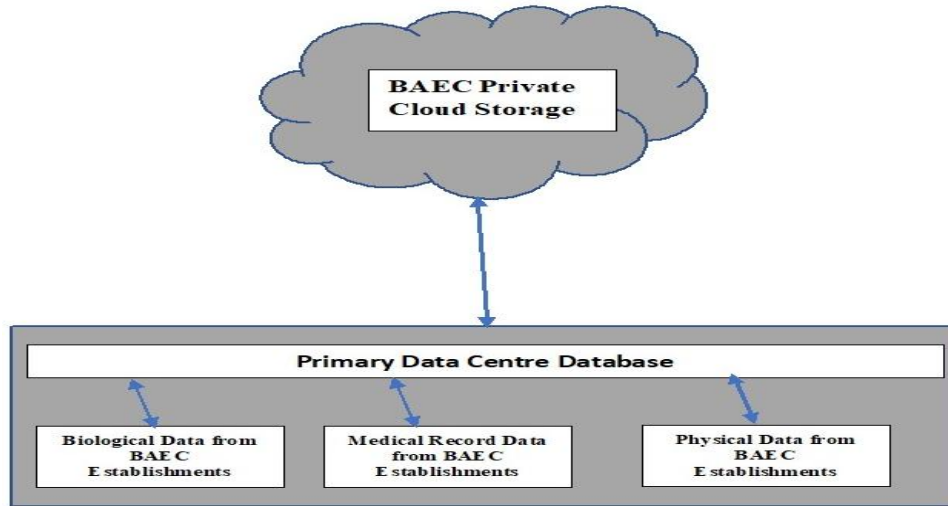


Fig 4. System Architecture: Private Cloud Storage for BAEC Establishments to meet up the Big Data Challenges

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.

CapEx costs calculation matrices/ measures of a Data centre preparation:

Cost Calculation Source[7]

Cloud Cost will be analyzed under the following factors such as the Engineering Consultation Demolition & Outside preparation, Material Cost, Labour Cost, Environmental Control, Security and Monitoring, Power Management, etc. Cloud and Management Servers, Racks, Top of Rack Switches, Core Switches, Firewalls and Backup Appliance are also the mandatory choices for the Cloud Setup we listed.

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 researches in place to discuss more on the security of cloud in a virtualized environment and how to handle more incoming 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 Development and Expansion of Data Center Implementation in BAEC.

M. S. Islam, K. N. S. Mitu, M. H. Ali, M. D. Hossain, M. S. Ahmed.

The establishment and development of the Data Center at the head quarter of BAEC is an ongoing development. At this data center Infrastructure development of hardware level with server room, Network Server Installation and maintenance has already been completed. Relevant Software development activities are going on such pay-roll management system of BAEC HQ. This data center is very important for the commission as a part of the digitalization of its ongoing manual activities.

1.6 Implementation D-Nothi System at BAEC and its Regional Offices.

Md. S. Islam, M. A. Uddin, M. D. Hossain

Currently, BAEC and its regional offices surrounds are converted from e-Nothi System to D-Nothi System. The D-Nothisystem has been changed and or updated several times according to its need. It's totally comprised of module based system. BAEC and its regional offices has implemented D-Nothi System under the supervision of Institute of Computer Science. The admin of D-Nothi system who is from the NCSD division of ICS at BAEC plays a vital role for implementing and administrating the system. The admin is responsible to join an employee to the system, can make resign the employee by taken order from higher authority, Nothi headings edit, any mistaken correction, training to employees etc related activities.

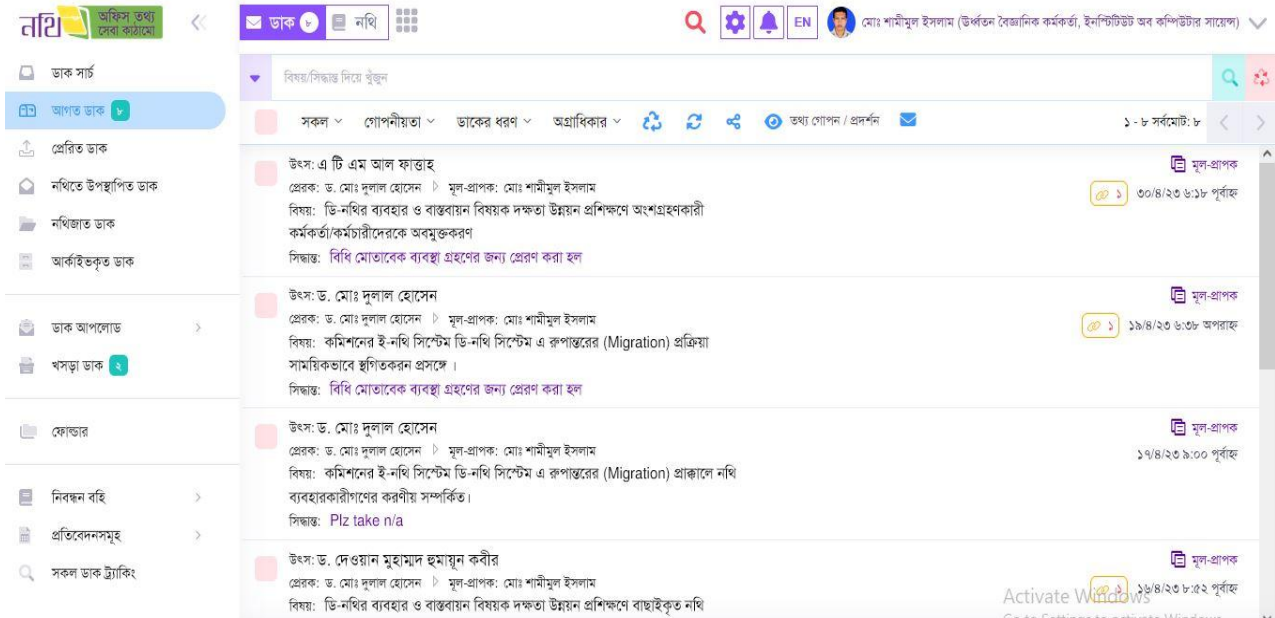


Fig.- Overview of D-Nothi System.

2. Manpower Development

(Arranged Training program /Arranged Workshop /Arranged Seminar /Arranged Symposium /Arranged Conference)

Sl.	Title of the event	Date	Organizer	No. of participant
a)	e-Nothi Office Management System at AERE	08-12 January 2023	Institute of Computer Science (ICS), AERE	25

3. Seminar/Symposium/Conference/Workshop/Meeting Attended:

Name of the participant	Title of event	Organizer	Date	Place
Md. Shamimul Islam Mohammed Asraf Uddin Dr. Md. Dulal Hossain	IEEE Computer Society Bangladesh Chapter Summer Symposium 2021	IEEE Computer Society Bangladesh Chapter	13-14 November, 2022	Zoom Platform
Kh. Nuba Shittain Mitu	A Virtual Training/Workshop on Artificial Intelligence and Machine Learning: BCSSGAI (British Computer Society Specialist Group on Artificial Intelligence)	British Computer Society	15-21 October, 2022	Zoom Platform

4. Service Rendered

Sl. No.	Name of service provided	Number/quantity of service provided
a)	BAEC Domain based Official Email Services	180
b)	Management Information System Administration Services	411
c)	E-Nothi Administration Services	550
d)	Consultation to the Scientists on the Computer and ICT	508
e)	Wi-Fi Internet Security Services	625

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 security, social security and territorial security. Institute of Energy Science has been started functioning in 3 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

Activities

1. Research and Development work(s)

1.1 Development of an optimized thermodynamic model for VVER-1200 reactor-based nuclear power plants using genetic algorithm

Mohammad Mizanur Rahman

In this work, an optimized thermodynamic model for the secondary coolant loop of a VVER-1200 reactor-based nuclear power plant is developed. The values of some of the thermo-physical parameters such as coolant flow rate, coolant inlet and outlet temperatures from the steam generator and the turbines, etc. are obtained from the available literature. On the other hand, the unknown plant parameters such as feedwater heater pressures are predicted using a Genetic Algorithm-based optimization process. Three crossover rates, 0.5, 0.7 and 0.9, and three mutation rates, 0.01, 0.05 and 0.1, are considered. Results reveal that the value of the optimization process of the thermodynamic model is not significantly affected by the change in the crossover rate or mutation rate. The optimized model is compared with two theoretical models, a model available in the literature and experimental data. Results reveal that the predicted values of the optimized model are more accurate compared to the other available options. The optimized model also predicts that the maximum overall efficiency and the maximum output power of a plant situated in tropical region should be around 35.87% and 1152.16MWe respectively for 28°C tertiary coolant temperature, down by 3.94% from the rated values in cold weather. However, the power output at 35°C tertiary coolant temperature is calculated to be 1117.88 MWe, almost 6.69% lower than the rated value for VVER-1200. Thus, the efficiency of the plant is highly sensitive to the weather variation of a region.

1.2 Customization and Application of Decision Support System JRODOS for Nuclear and Radiological Safety Problems of VVER-1200 Nuclear Reactor

S.M. Tabirul Hassan, Md. Abu Khaer, Md. Ajijul Hoq, Mohammed Tareque Chowdhury, Mohammad Mizanur Rahman

At present, two nuclear power plant of VVER -1200 technology, a generation III+ reactor, type AES-2006/V-392M (1200 MWe) is under construction that is expected to start operation in 2023 at Rooppur, Paksey Union, Ishwardi Upazilla, Pabna district, Bangladesh. From the two units of Rooppur Nuclear Power Plant (RNPP), it is planned to generate a total power of 2.4 GWe. Simulation of accident scenarios for nuclear facilities is of the utmost important tool to estimate the prospective radiological consequences of an emergency. Such simulation assessments support authorities to develop the potentiality for emergency preparedness and response (EPR) arrangements. JRODOS is a real-time on-line decision support system for operational use in emergency response management after nuclear or radiological accidents. The goal is to provide all the information required to decide on measures to protect the population quickly, continuously, consistently and comprehensively. It requires appropriate meteorological data and a good source term along with several other parameters to model a radiological accident on a specific site. A Source Term contains all the necessary information about the amounts of released nuclides along with the timing of their release after any radiological accident.

Importance of correct estimation of Source Term (ST) of any nuclear or radiological accident relies on the fact that the spread of radionuclides after released to the environment in terms of both intensities of doses and population area is directly dependent on it. A good estimation of ST along with reliable meteorological data are necessary to prepare an emergency planning and take appropriate actions in case of any nuclear or radiological accident. To modify ST data directly using JRODOS is easier for a simpler data set. One can manually select release time, radionuclides and their activities over different time intervals. As long as the nuclides and intervals are fewer in number, one is less prone to make errors inserting the data manually. But when the nuclides and time intervals keep getting larger in number it's very difficult to keep track of whether the data are being inserted correctly. This can in turn affect reliability of the final analysis. For a larger set of source term data with many more nuclides and time steps it is better to use a JRODOS Standard XML or CSV formatted file containing the necessary information of radionuclides activities over respective time intervals. Although there are dedicated computational code like RASCAL or ORIGEN which can produce the source term data directly in CSV format but it would have to be converted in a JRODOS compatible format anyway.

1.3 Dose Distribution of Radioxenon due to a Hypothetical Accident of TRIGA Research Reactor in Bangladesh

Md. Ajijul Hoq, Md. Abu Khaer, Mohammed Tareque Chowdhury, Mohammad Mizanur Rahman

Radiological dose distribution owing to the deposition of ^{131m}Xe , ^{133m}Xe , ^{133}Xe , ^{135m}Xe , ^{135}Xe , and ^{138}Xe on ground and immersion considering a postulated accident of TRIGA Mark-II research reactor of Bangladesh has been assessed. The radiological dose distribution has been carried out in various directions with the help of Gaussian Diffusion Model. Local meteorological data such as average wind speed, frequency, etc. has been collected and evaluated for various directions around the reactor site. For all the dominant directions, the maximum dose values due to ^{131m}Xe , ^{133m}Xe , ^{133}Xe , ^{135m}Xe , ^{135}Xe , ^{138}Xe and the total ($^{131m}\text{Xe} + ^{133m}\text{Xe} + ^{133}\text{Xe} + ^{135m}\text{Xe} + ^{135}\text{Xe} + ^{138}\text{Xe}$) were observed within the limit $3.03\text{E}-7$ – $1.23\text{E}-4$ $\mu\text{Sv/hr}$, $1.01\text{E}-5$ – $4.09\text{E}-3$ $\mu\text{Sv/hr}$, 0.0003 – 0.14 $\mu\text{Sv/hr}$, $2.29\text{E}-5$ – $9.26\text{E}-3$ $\mu\text{Sv/hr}$, 0.002 – 1.11 $\mu\text{Sv/hr}$, $1.11\text{E}-5$ – $4.55\text{E}-3$ $\mu\text{Sv/hr}$, and 0.003 – 1.269 $\mu\text{Sv/hr}$, respectively. Dose distribution was found to be dominant due to immersion and the contribution was 87.55%. There is shortage of data regarding the release of radioxenon in the atmosphere during nuclear accident specially in the case of TRIGA type research reactor. This paper is the first such detailed study on atmospheric release of radioxenon and its dose distribution for a full power-operated TRIGA type reactor and the consequences towards the environment and public health. The result extracted from this study can be applied to develop the radiological protective measures and to prepare an emergency response plan for the TRIGA reactor site.

1.4 Radiological Dose and Emergency Planning Zones Assessment of BAEC TRIGA Mark-II Research Reactor due to a Postulated Severe Accidental Condition

Md. Abu Khaer, Md. Ajijul Hoq, S.M. Tabirul Hassan, Mohammed Tareque Chowdhury, Mohammad Mizanur Rahman

Radiological dose and emergency planning zones assessment have been conducted for dry and rainy season of the Bangladesh TRIGA Mark-II research reactor. A postulated severe accident of plane crash was considered in this analysis. Due to complete reactor building and core damage, core inventory radionuclides were released at their highest release fraction. In this instance, doses due to release of radionuclides such as Xe, Kr, I, and Cs were estimated using two different atmospheric dispersion model with the help of meteorological data collected from Bangladesh Meteorological Department (BMD). The source term analysis has been performed using ORIGEN 2.1 code. The HotSpot 3.1.2 and RASCAL 4.3 codes were used for the assessment of radiological doses. The TEDE and thyroid CDE doses were found much higher than permissible limit in large area from both RASCAL 4.3 and HotSpot 3.1.2 codes. From the assessment during dry season, the evacuation distances were obtained approximately 3.7 km and 13.0 km and sheltering distances were obtained almost 13.0 km and 40.0 km following IAEA and European Commission criteria. Contrarily, during the rainy season, the evacuation distances were found roughly 5.5 km and 8.5 km and the sheltering distances were found roughly 8.5 km and 12.0 km according to the criteria set forth by the IAEA and the European Commission.

1.5 Core Inventory and Radiological Consequences Analysis of BAEC TRIGA Mark-II Research Reactor due to a Postulated Accident

Md. Abu Khaer, Md. Ajijul Hoq, S.M. Tabirul Hassan, Mohammed Tareque Chowdhury, Mohammad Mizanur Rahman

Postulated nuclear reactor accident analysis does not lose its demands. It is always important to take protective actions not to commit enough radiological dose. Hence, the present study focused on the core inventory and radiological dose assessment due to a postulated accident of the TRIGA Mark-II research reactor at AERE, Savar, Dhaka, Bangladesh. Core inventory and source term of five radionuclides (^{137}Cs , ^{131}I , ^{90}Sr , ^{85}Kr , and ^{133}Xe) were analyzed for 365 days of operation at full power (3 MW_{th}) and these radionuclides were selected based on their high emission phenomena from a nuclear accident. The HotSpot 3.1.2 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 (BMD) were used for the dose assessment and doses were calculated in the three dominant directions South (S), Southeast (SE), and West (W). The TED and Thyroid dose values are assessed and compared to the PAZs dose criteria of U.S. Environmental Protection Agency. These data may help to take protective actions like evacuation, sheltering and iodine tablet consumption for the same type of accidental situation.

2. Seminar/Symposium/Conference/Workshop/Meeting Attended

Name of the participant	Title of the event	Organizer	Date	Place
Dr. Mohammad Mizanur Rahman	3 rd Research Coordination Meeting of the CRP J15002	IAEA	29 August-2 September 2022	Virtual meeting
Dr. Mohammad Mizanur Rahman	23 rd Meeting of the Academic Committee for Post-Graduate studies (ACPG)	KUET	11 December 2022	Department of Energy Science and Engineering, KUET
Dr. Mohammad Mizanur Rahman	22 nd Meeting of the Academic Committee for Post-Graduate studies (ACPG)	KUET	20 October 2022	Department of Energy Science and Engineering, KUET
Dr. Mohammad Mizanur Rahman	Research under Special Allocation Project: Findings and Applications	MOST	17 May 2023	BRICM, BCSIR
Dr. Mohammed Tareque Chowdhury	3 rd Research Coordination Meeting of the CRP J15002	IAEA	29 August-2 September 2022	Virtual meeting

Name of the participant	Title of the event	Organizer	Date	Place
Dr. Mohammed Tareque Chowdhury	Learning session APA, 2022-23	SID, BAEC	22 December 2022	Zoom platform
Dr. Mohammed Tareque Chowdhury	National conference on Physics-2023	Bangladesh Physical Society	11 March, 2023	Jahangirnagar University
S. M. Tabirul Hassan	Learning session APA, 2022-23	SID, BAEC	22 December 2022	Zoom platform
S. M. Tabirul Hassan	Workshop on 4IR related tools and technology adaptation to conquer its challenges	PDD, BAEC	23 January, 2023	BAEC HQ
S. M. Tabirul Hassan	Workshop on towards zero carbon Asia	BUET & UNEP	15 March, 2023	Hotel Intercontinental
Dr. Md. Ajijul Hoq	Fellowship Training on 'Design and building test facilities.'	IAEA	28 Nov.-27 Dec., 2022.	Kyushu University, JAPAN.
Md. Abu Khaer	Training course on PPR-2008 and Public Procurement Management	BAEC	10-20 October 2022	Training Institute, AERE
Md. Abu Khaer	Training on E-Nothi Office Management	BAEC	08-12 January 2023	Institute of Computer Science, AERE

3. Collaboration work/MoU

(a) Special Allocation Project:

Radiological Safety Analysis due to Accidental Release of ^{137}Cs , ^{131}I , ^{133}Xe , $^{85\text{m}}\text{Kr}$ and ^{90}Sr from TRIGA research Reactor., Principal Investigator: Dr. Mohammad Mizanur Rahman, Associate Investigator: Dr. Md. Ajijul Hoq, (Project ID: SRG-226622, Financial year: 2022 – 2023)

(b) IAEA CRP Project (J15002):

Application of Dose Assessment Codes for Nuclear and Radiological Emergency Preparedness and Response of Nuclear Installations of Bangladesh, Chief Scientific Investigator: Dr. Mohammad Mizanur Rahman, Director, IES (Contract No. 23876/RO, Cycle: January 2020 - December 2022, Status: On-going)

(c) IAEA TC project (BGD1013):

Strengthening capacity in the design and development of spent fuel storage and reactor safety testing laboratory.

Role of this institute: Capacity building for the design of a thermal hydraulics and reactor safety testing laboratory.

Counterpart: Dr. Mohammad Mizanur Rahman (Cycle: 2018-2019, Statue: On-going)

(d) 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.

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:

- i) Application of radiation processing technologies for the socio-economic development of the country.
- ii) Providing commercial gamma irradiation services for quality improvement of food items and sterilization of medical products, pharmaceutical raw and packaging materials etc.
- iii) To provide irradiation service to research organizations for R & D purpose.
- iv) To expand cooperation with other scientific organizations, universities, private and public sectors through mutual exchange of educational programs, training, technical cooperation and expert services.
- v) To develop human resources in the field of nuclear science and technology.
- vi) Transferring the technology to the entrepreneurs for industrial applications.

Activities

1. Research and Development work(s)

1.1 Development of Different Polymeric Composite Materials for Structural Applications and Radiation Shielding:

Mechanical properties of various composite polymeric materials are improved by the direct exposure to different doses of radiation. Various natural fiber and synthetic matrix materials have been utilized for the property improvement of the polymer composites. In continuation, research has been led for development of the radiation shielding materials. Manufacture and characterization of Jute Fabrics Reinforced Polymer based composites were carried out and comparative study between hand Lay-up and Compression Molding Technique were conducted. Impact of sand on mechanical properties of Jute Fabrics Reinforced Polypropylene based composite has been determined. Fabrication and characterization of Carbon Kevlar Reinforced Polypropylene based composites were done. Physio-mechanical property of unidirectional Jute Fiber Reinforced Polypropylene and Linear Low-Density Polyethylene based composite were determined and impact of dye observed.

1.2 Development of Advanced Materials for Biomedical, Environment Application:

Different types of hydrogels were prepared for biomedical application and heavy metal removal.

1.3 Use of Radiation, Chemical and Microbiological Tools for Water Treatment for Different Uses:

Physio-chemical and microbiological quality assessment of surface water of Turag River, Buriganga river and different 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 of the Buriganga River. 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.

1.4 Dye sensitized Solar Cells (DSSCs) were constructed with TiO_2 and ZnO nanoparticles and the effect of gamma (γ) radiation on them was determined.

1.5 Green synthesis of BaO nano materials was done and the effect of gamma (γ) radiation on them was examined.

2 Repair, Maintenance and Renovation works

- Installation of UTM machine and started working properly.
- Installation 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.

3 Manpower Development

Name of the participant	Title of the event	Date	Organizer	No. of participants
Dr. Ruhul Amin Khan, Director, IRPT	Studies of Corrosion Properties of Alloy 600 and Alloy 690 used in Nuclear Power Reactor	22 March, 2023	Seminar Room, IRPT, Savar, Dhaka	15
Dr. Ruhul Amin Khan, Director, IRPT	Gamma radiation	12 December, 2022	Seminar Room, IRPT, Savar, Dhaka	16
Md. Marjanul Haque, SO, IRPT	Nuclear/ Radiological Safety Culture Analysis	15 February, 2023	Seminar Room, IRPT, Savar, Dhaka	16
Md. Razzak, PSO, IRPT	UV-Radiation	01 January, 2023	Seminar Room, IRPT, Savar, Dhaka	16
Md. Serajum Monir, SSO, IRPT	Protection of Radioactive Sources	06 March, 2023	Seminar Room, IRPT, Savar, Dhaka	14

4. Seminar/Symposium/Conference/Workshop/Meeting Attended

Name of the participant	Title of the event	Organizer	Date	Place
Dr. Ruhul Amin Khan, Director, IRPT	IAEA/RCA Regional Workshop on Food Irradiation Using Electron Beam/ X-ray Technology	IAEA	1-5 August 2022	Cairns, Australia
Dr. Ruhul Amin Khan, Director, IRPT	International Meeting on Radiation Processing	iia	7-11 November 2022	Bangkok, Thailand
Md. Zahirul Islam Mollah, PSO, IRPT	Training Course on Addressing Insider Threats for Radioactive Materials and Associated Facilities	IAEA	25-29 July 2022	Vienna, Austria
A K M Moshikul Alam, PSO, IRPT	Accelerating the Adoption of e-Beam/X-ray technologies in Asia and the Pacific	RCARO	14-18 November 2022	Daejeon, Korea
Md. Rabiul Islam, SSO, IRPT.	Accelerating the Adoption of e-Beam/X-ray technologies in Asia and the Pacific	RCARO	14-18 November 2022	Daejeon, Korea
Md. Marjanul Haque, SO, IRPT	Training Workshop for Safety Culture Continuous Improvement	IAEA	19-23 June, 2023	Vienna, Austria
Md. Mukul Hossain, SSA, IRPT	International Meeting on Radiation Processing	iia	7-11 November, 2022	Bangkok, Thailand

5. 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 2022 to June 2023 at IRPT.

Title	Place	Date
Experience Sharing Meeting with Stakeholders	Seminar Room, IRPT, AERE, Savar, Dhaka.	02 March, 2023
Experience Sharing Meeting with Stakeholders	Seminar Room, IRPT, AERE, Savar, Dhaka.	14 December, 2022

6. 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 (20 consignment)	Food Irradiation	69.23 Ton	46,74,547.10
c)	08 companies (18 consignment)	Pet Food	12.885 Ton	5,06,690.38
Total				51,81,237.10

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

Activities

1. Research & Development

1.1 Distribution of Natural Radionuclides and Gamma Dose Rates along the Gohira and Parky Sand Beaches, Chattogram, Bangladesh

F. Deeba, N.T. Dina, M.Z. Kabir and M.G. Rasul

Radioactivity in the coastal area has always been a matter of concern as millions of people live and travel around the area. The geological field work was conducted at the Gohira and Parki Beach along the coastline of the Bay of Bengal, Chattogram district. The aim of the research work was to investigate the natural radioactivity of the beach sand containing radioactive mineral (specifically uranium and thorium) and their radiological consequence. The radiometric Survey was conducted to measure the natural radioactivity using GF Instruments Gamma Surveyor-II along with radiation detector and dose rate monitor. The average in situ ^{238}U , ^{232}Th and ^{40}K concentrations of the studied sample is 106.62 ppm, 146.72 ppm and 2.45% respectively with the corresponding dose rate of 674.54 nGy/h. All of these values exceeded the world acceptable limits. The average value of radiological hazard indices like absorbed dose rate (D), annual effective dose equivalent (AEDE), radium equivalent activities (Ra_{eq}), external hazard index (H_{ex}), internal hazard index (H_{in}) and excess life cancer risk (ELCR) are 960.5 nGy/h, 1.23 mSv/h, 2140.755 Bq/Kg, 6.07, 9.67 and 4.33×10^{-3} respectively and all these value exceeded the world admissible values. The analytical data will be helpful to the inhabitants for understanding radioactivity levels in the beach sand which will provide awareness about the radiological health hazard. Moreover, it may be helpful as reference data for future studies for complete radioactivity mapping at the coastal area of Bangladesh.

1.2 Grain Size Distribution and Depositional Pattern Characterization of Sediment from the Someshwari River, Bangladesh.

N.T. Dina, F. Deeba, M.G. Rasul, M.Z. Kabir, M. Rajib, M. Moniruzzaman, S.C. Das and T. Saha

Grain size is the most fundamental property of sediments, which provide details information of the interior properties of sediment discharge and depositional environment. In the present investigation, fifteen sample were analyzed from the Someshwari River, Netrokona district, Bangladesh, in order to identify its textural signature and depositional environment. All selective samples were dried in sunlight, then about 500 grams samples were taken and sieved by Restch ASTM type Sieving machine for 30 minutes using 0.5 mm, 0.25 mm, 0.125 mm, 0.063 mm and a pan. Finally, the fractionated part was weighed using analytical balance and the weight percentages of individual sieve fraction were calculated. Grain size distributions were processed according to Folk and Ward grain size statistics (e.g., mean, Skewness, sorting, and Kurtosis) through GRADISTAT software. Graphic Mean, Standard deviation, Skewness and kurtosis values ranges from 0.75Φ to 2.09Φ , 0.15Φ to 0.93Φ , -0.1941Φ and 0.574Φ and 0.661Φ to 2.224Φ respectively. The studied sand samples were dominantly medium grained, moderately sorted, very positively skewed and platykurtic in nature, which were deposited under moderate to low energy conditions with dominant rolling and suspension processes.

1.3 Geochemical and Mineralogical Characterization of Heavy Minerals in Chalti River Sand Deposits, Sunamganj, Bangladesh.

F. Deeba¹, N.T. Dina¹, M.G. Rasul¹, M.Z. Kabir¹, M. Rajib¹, M. Moniruzzaman¹, S.C. Das¹, T. Saha¹, and M. N. I.Khan²

¹Institute of Nuclear Minerals, Atomic Energy Research Establishment, Dhaka, Bangladesh.

²Material Science Division, Atomic Energy Center, Bangladesh Atomic Energy Commission, Dhaka, Bangladesh

River transported alluvial sediments contain heavy minerals, which generally deposited on the river bed forming heavy mineral rich sand bars. An attempt has been made under this research work to determine the types and amounts of heavy minerals in the river born sands. Heavy mineral (HM) concentrations in sand bar deposits of the Chalti River, Sunamganj were evaluated using Polarizing Microscopy study and X-Ray Diffraction (XRD). Heavy mineral separation was carried out using heavy liquid bromoform (CHBr₃) of 2.89 specific gravity as per the standard procedures outlined by Milner. Samples from 10 locations from upstream to downstream along the Chalti River are found to contain different heavy minerals concentration with a range of 2.53 – 65.63, (weight %). The mineral phase identification was performed from the heavy fraction part using Philips X'Pert Pro Multipurpose X-ray diffractometer which uses copper K α radiation. X-ray generator operated at 40 kV and 30 mA, and all scans were run at a speed of 2° per minute, from 10° to 70°, with a continuous step size of 0.02. Mineral characterization from peak positions in diffractogram of XRD suggests the presence of heavy minerals namely amphibole (hornblende), chlorite, rutile, magnetite, illmenite, zircon, garnet and monazite.

1.4 Hydrogeochemical Characteristics and the Pollution Level of Groundwater at the Eastern Coastal area of the Chattogram, Bangladesh.

N.T. Dina¹, F. Deeba¹, M.Z. Kabir¹, M.G. Rasul¹ and M. F. Alam²

¹Institute of Nuclear Minerals, Atomic Energy Research Establishment, Dhaka, Bangladesh

²Nuclear and Radiation Chemistry Division, Institute of Nuclear Science and Technology, Dhaka, Bangladesh

Hydrochemical study is carried out in the aquifer system of Gohira and Parki Beach along the coastline of the Bay of Bengal, at the east of the Chattogram district, Bangladesh to investigate the hydrochemical processes and the pollution level of groundwater. The physical properties like temperature, pH, electrical conductivity (EC), total dissolved solid (TDS), Total Hardness (TH) and salt content (ppt) of the groundwater were measured on site by portable HANNA instrument (HI 2211) for pH and (HI 5321) for EC, TDS, TH and Salinity. Major anions like bicarbonate (HCO₃⁻), carbonate (CO₃⁻), chloride (Cl⁻) and nitrate (NO₃⁻), were analyzed using the standard methods given by the American Public Health Association (APHA 1995). The water samples were filtered through 0.45 mm Millipore membrane filters to separate suspended particles. Acid titration methods were used to determine the concentration of bicarbonate (HCO₃⁻) in water (APHA 1998). Major anions (Cl⁻ and NO₃⁻) were analyzed by UV-VIS spectrophotometer (UV-3401, Shimadzu, Kyoto,

Japan). Average pH, EC, TDS, TH and salt content are 6.99, 131.21 μ S/cm, 71.19 mg/L, 148.88 mg/L and 1.292 ppt respectively, which is within the WHO (2011) and DoE (1997) standard limit. Pearson correlation analysis showed a significantly positive correlation between EC, TDS and Salinity. The principle anions in groundwater were in the following order $\text{HCO}_3^- > \text{CO}_3^{2-} > \text{NO}_3^- > \text{Cl}^-$ with their corresponding average value of 397 mg/L, 378 mg/L, 23.79 mg/L and 21.66 mg/L. Among the anion, only HCO_3^- concentration exceed the acceptable limit (300 mg/L) prescribed by WHO (2011).

1.5 Radioactive and Rare Earth Element (REEs) Exploration at Tertiary Sediments at Juri and Fultala Area, Moulovibazar District, North-East Bangladesh

M. Rajib, M.G. Rasul, M.Z. Kabir, F. Deebea, M. Moniruzzaman, N.T. Dina, S.C. Das, T. Saha, M. Asaduzzaman and M. J. Uddin

As part of regular exploration activity of the institute, a radiometric exploration of the season 2022-23 was conducted at various locations of Juri and Fultola areas of Moulovibazar district during February 2023. Objective of the survey was to investigate radioactive minerals presence in the exposed Tertiary sediments. Juri and Fultala area are historically reported for noticeable presence of uranium and thorium bearing minerals in the exposed geological formation by several previous studies. The studied area is entirely covered by the tea gardens which are characterized by 5-100 meters high hillocks and valleys. Hillocks are composed of mostly massive sandstones of Tipam formation at the middle with sticky clay of Dupitila at top, and shale and sandstone layers of Bokabil formation at bottom. 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 45 sampling points in between latitude 24°23.553 to 24°31.022 and longitude 92°2'187 to 92°7.916, as measured by Garmin ETREX 22X GPS system. Focus was given mostly to Tipam sandstone part where relatively higher gamma radiation was observed. Along with sediment samples, water from different streams coming from various parts of the hillocks were also collected to investigate the constituent radioactive elements. Results showed the presence of 3.63-6.62 ppm of U-238 (averaging 4.68 ppm), 6.96-14.11 ppm of Th-232 (averaging 9.58 ppm) and 0.24-2.01% of K-40 (averaging 1.02%). Such radioactivities pose corresponding dose rates of 45.34-91.94 nGy/hr as measured by Gamma Surveyer (averaging 64.07 nGy/hr). From the personal dosimeter and GM counter, the absorbed dose to human being was found to be 0.13-0.14 μ Sv/hr which is just at the boundary line of the WHO accepted values for general public. Samples were taken each location to measure the mineralogical composition, elemental concentration and radioactivity using various laboratory techniques.

1.6 Radioactive Minerals Exploration at Fluvial Depositions at Dharla and Dudhkumar River, Lalmonirhat, Northern Bangladesh

M. Rajib, M.G. Rasul, M.Z. Kabir, F. Deebea, M. Moniruzzaman, N.T. Dina, S.C. Das, T. Saha, M. Asaduzzaman and M. J. Uddin

Geological exploration activities were carried out in the recent fluvial depositions of Dharla and Dudhkumar river at Lalmonirhat District. Objective was to explore the presence of radioactive minerals in the river transported sediments through the two transboundary rivers. Portable gamma-ray spectrometer (Gamma Surveyer II), Geiger counter (BR-9C series radiation detector) and Individual Dose Rate Meter (FS2011) was utilized to measure in-situ uranium (U-238), thorium (Th-232) and potassium (K-40) along with their corresponding dose rates. Besides, samples were collected using hand augering system from surface to upto 10 feet below the surface, wherever possible at 3 feet interval. As many as 52 data from 26 sampling points (17 from Dharla and 9 from Dudhkumar) were collected along with corresponding samples of approximately 5 kg each. The in-situ data as found are- U-238: range 3.19-12.13 ppm, Th-232: 6.66-18.67 ppm, K-40: 0.80-1.51% with the corresponding dose rate of 49.4-126.46 nGy/yr. The field results suggest below average presence of radioactive materials in the recent transported sand through studied two rivers.

1.7 Radioactivity Distribution along the Marine Drive at Cox's Bazar Coastal Area, Bangladesh

M. Rajib and M. G. Rasul

Measurement of radioactivity from uranium and thorium content with environmental potassium presence was conducted under the special allocation fund of Ministry of Science and Technology (MoST) for the FY 2022-

23. The investigation was done as part of radioactive and rare earth element containing minerals exploration in the coastal environment of Bangladesh. The geological field survey was carried out at the entire marine drive of approximately 90 km length (from Sabrang zero point to Diabetic point, Cox's Bazar) with a portable gamma-ray spectrometer (Gamma Surveyer II), and Individual Dose Rate Meter (FS2011). The Gamma Surveyer II provides U-238, Th-232 content in ppm and K-40 in percentage level with their corresponding dose rate in nano-Grey per hour, whereas FS2011 measures the personal dose rate in micro-Sievert per hour ($\mu\text{Sv/hr}$). Measurement was taken at 4–5-kilometer interval, from as many as 28 sampling points and approximately 50 meters from the east and west side of the marine drive. Many of the east side samples belong to backdune environment where as all of the west side include the recent deposition at foredune area. In addition, as much as 5 kgs of sand samples were collected from 5 heavy mineral deposit areas, namely Sabrang, Teknaf (Lengur Bill area), Shilkhali, Inani (Sonarpara area) and Cox's Bazar (kalatoli area). In total, 50 data with 5 above-mentioned parameters were noted to prepare the radioactivity distribution map of the studied area.

1.8 Operation, Maintenance and Calibration of Auxiliary Seismic Station of CTBTO (AS-007, BRDH)

M. Rajib and M. G. Rasul

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, usually twice a year. This calibration is also necessary for the International Data Centre (IDC) to effectively use the captured data from AS-007. As part of O&M activities, the Authorized Users of NDC-BD participated in various workshop, conference and training to successfully run the CTBTO facility.

1.9 Variation of Radioactivity Due to Gamma Irradiation Effect on Separated Minerals

M. Rajib and T. Saha

Separated beach minerals of Bangladesh, namely ilmenite, magnetite, rutile, zircon, garnet, monazite and silica were undergone gamma irradiation. Individual minerals were separated from beach and river sands and upgraded to best possible physical grade by density, magnetic and electric separators. Gamma dose of 10K and 100K Grey (mGy) was provided by the Co-60 source with 100% source efficiency. Radioactivity was measured before and after irradiation with a portable gamma-ray spectrometer (Gamma Surveyer II) that measures U-238, Th-232 and K-40. Each sample was taken at equal volume (approximately 6.28 ml) in test tubes in a lead-shielded container. The lead shielding suppressed all background radiation providing a zero value for K-40 and U-238 in all samples. However, it was observed that Th-232 was increased at most of the non-irradiated samples to irradiated ones with increasing radiation except rutile, which showed opposite tendency. Dose rates also followed similar trend in respective samples. The study would provide the characterization of those minerals for various application.

1.10 Toxic Metals in the Sediments of the Exposed Tertiary Geological Formations from Jaintiapur, Sylhet, Bangladesh: Environmental and Ecological Implications

S. C. Das, N.T. Dina, F. Deeba, M. Rajib, M.Z. Kabir, M. Moniruzzaman, M.G. Rasul

This research aims to determine the concentrations of seven metals to evaluate the environmental and ecological risks in the surface sediments of Jaintiapur, Sylhet, Bangladesh due to the growing worldwide concern about the harmful metal contamination in sediments. A total of thirteen samples were collected and analyzed using instrumental neutron activation analysis (INAA) for seven toxic metals. The mean concentrations of toxic metals (in ppm) of the analyzed sediments in order of abundances are Mn (288) > Cr (126.73) > Zn (122.52) > V (97.36) > Co (19.76) > As (11.58) > Sb (1.34) where all the metals exceed the averages of upper continental crust (UCC) values except Mn. The mean values of geo-accumulation index vary from -2.05 to 0.1 (uncontaminated), enrichment factors 0.38 to 4.10 (Mn and Co, depleted and others metals, moderately enriched), contamination factor 0.37 to 3.21 (low to moderate to considerably polluted) whereas

the element specific environmental risks (Eri) ranges from 0.37 to 32.08 (low risk) and cumulative potential ecological risks (RI) 67.83 (low risk). The indices based evaluation revealed that Sb and As were the principal pollutants of surface sediments, while the other metals exhibited background concentration to moderate contamination. With the exception of J10, J8, J7, and J5 locations, the pollution load index values revealed that practically all of the sample sites were unpolluted with the studied metals. The research concludes that the Jaintiapur region has little anthropogenic effect and has few ecological risks.

1.11 Trans-boundary river sediments across the Dauki fault belt at the north-east Bangladesh: Environmental radioactivity and radiological consequences

S. C. Das, N.T. Dina, T. Saha, M. Moniruzzaman, M. Rajib, F. Deeba, M.Z. Kabir, M.G. Rasul

Primordial radionuclides present in the river sediments pose varying degree of environmental and health risks. In this research, the radioactivity concentration in the several transboundary river sediments flowing across the Dauki fault belt, north-east Bangladesh were measured using GF Instruments Gamma Surveyor-II. The average activity concentrations of uranium, thorium, and potassium were found to be 44.44 Bqkg^{-1} , 56.62 Bqkg^{-1} , and 275.25 Bqkg^{-1} , respectively from as many as 81 sampling points. The results show that average uranium and thorium concentrations are 1.5 to 2 times the world averages, suggesting uranium and thorium mineralization in the area, necessitating more investigation. The overall averages of different radiological indices results are for radium equivalent activity (140.51 Bqkg^{-1}), external and internal hazard index (0.40 and 0.52, respectively), absorbed dose rate (66.21 qGyh^{-1}), annual effective dose rate (0.08 mSvy^{-1}), gamma representative level index (1.05), activity utilization index (1.12), and radiation heat production ($9.28 \text{ (}\mu\text{Wm}^{-3}\text{)}$). Radiological indices data suggest that the radionuclides produce significant radioactive heat flux and radiation hazards which are essential to monitor regularly for the safe living of the inhabitants in the region.

1.12 Radiation Distribution at Workplace: A Case Study

T. Saha, M. Rajib and M.G. Rasul

Natural background radiation from primordial radionuclides such as ^{226}Ra , ^{232}Th , and ^{40}K in sediment, soil, water, and rock accounts for around 80% of the total radiation dosage a person receives in a year. Occupational workers in different laboratories who deal with various natural and artificial radioactive sources are allowed to receive more than general public, however, need to be under continuous monitoring. For this purpose, determination of radiation distribution at any workplace is necessary to continue such monitoring. In view of that, a total of 34 radiation measurements were collected at Institute of Nuclear Minerals (INM) of Atomic Energy Research Establishment (AERE) and its surroundings. The present study was aimed to investigate the additional doses any person of INM could receive during their stay at working hours. Environmental radioactivity as well as corresponding dose rate was measured using portable gamma-ray spectrometer along with a Geiger counter and environmental radiation detector at different rooms, laboratories and surroundings of INM as a part of routine radiation monitoring at the workplace. Sample data were collected from approximately middle of each 22 rooms and other 12 values from equal distance from the institute building. The measured radiation of ^{238}U , ^{232}Th , and ^{40}K were in the range of 4.25-13.79 ppm, 8.88-17.95 ppm and 0.93-2.23%, respectively. Correspondingly, the observed dose rates from individual dosimeter were found to be in the range of 0.09-0.21 $\mu\text{Sv/h}$. It can be mentioned that laboratories of INM regularly analyze different geological samples which may contain radioactive materials. Before processing those samples, they are usually kept in the sample store where radioactivity was found higher than average. In addition, higher dose rates can also be observed from the uncovered building materials, e.g., old mosaic materials at floors of the building. Combining these, increased dose rates are evident at the northern side of the building. Although, the dose rates are within the allowable limit as regularly monitored by Thermoluminescence Dosimeter (TLD) for the employees of INM, considering 8 hours a day and 22 days a month, an employee engaged with radioactive mineral processing might be exposed to additional doses which can be significantly above the dose limit for an occupational worker in a year (20mSv).

1.13 Shoreline Dynamics at Sonadia Island Using Satellite Images: An Approach to Investigate New Heavy Mineral Deposition.

T. Saha and M. Rajib

Coastal regions are dynamic, the sites of active and rapid geomorphological changes driven mainly by the slow however steady change in sea level and the strong processes particularly wave action for erosion and sediment transport. Coastal dunes on Sonadia Island are distinct and possibly rich in economically valuable minerals. The island area is 15km in length and 4km in average width and lies between latitude 21°28'N to 21°33'N, and longitude 91°50'E to 91°56'E and consists of active tidal flats primarily formed by sandy sediment deposition. This study was conducted via historical satellite image analysis mainly Landsat image between 1972 and 2022. Sentinel images were used to determine net annual shoreline displacement of Sonadia Island revealing continuous and rapid morphological changes of the sandbars and their heavy mineral prospect supported by field work and sample analysis. Several geospatial tools such as ArcGIS, ERDAS Imagine were used for satellite image processing and analysis. The dunes run along the entire coast and are also fringed several hundred meters inward. The satellite imagery analysis revealed that the highest erosion rate observed is 36.5 m/yr and accretion is 63.4 m/yr, with the area change analysis showing 12.6 km² and 17.1 km², respectively. Samples were collected from 10 different locations using hand auger and their GPS locations were also noted. Portable surveymeter was utilized to define new heavy mineral deposition. Further laboratory study is underway to confirm the heavy mineral presence at the accredited land of the Sonadia Island.

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)	Internship program for the students of Dept. of Geological Sciences, Jahangirnagar University.	5 (five) days; 11/06/2023- 15/06/2023	Seminar Room, Institute of Nuclear Minerals, AERE	17

3. Seminar/Symposium/Conference/Workshop/Meeting Attended

Name of the participant	Title of the event	Organizer	Date	Place
Dr. Md. Golam Rasul	Workshop on the Operation and Maintenance of the IMS	CTBTO	28 November- 02 September, 2022	Vienna, Austria
	CTBTO, Science and Technology conference, 2023	CTBTO	19-23, June, 2023	Vienna, Austria
Farah Deebea	NDC Capacity Building Workshop	CTBTO	04-08, September, 2022	Muscat, Oman
	International Symposium on Uranium Raw Material for the Nuclear Fuel Cycle: Innovation for Sustaining Future Resources and Production (URAM-2023; Event Code- CN-311; EVT2102334).	IAEA	8-12, May, 2023	Vienna, Austria
Farah Deebea and Nafisa Tamannaya Dina	1st International Dhaka Science Conference for Women - 2023	Dhaka Nanomaterials Group, AECD	15-16 February 2023	Sonargaon, Dhaka
Dr. Mohammad Rajib	NDC Capacity Building: Waveform Training Course using SeisComp	CTBTO	28 November- 2 December 2022	Vienna, Austria
	The 2022 NDC Workshop	CTBTO	03-07 October, 2022	Toledo, Spain

Name of the participant	Title of the event	Organizer	Date	Place
	International Symposium on Uranium Raw Material for the Nuclear Fuel Cycle: Innovation for Sustaining Future Resources and Production (URAM-2023; Event Code- CN-311; EVT2102334).	IAEA	8-12 May, 2023	Vienna, Austria
Nafisa TamannayaDina	Workshop on “E-Governance & Innovation”	Innovation Team of Bangladesh Atomic Energy Commission	28 Nov 2022	Head Office, BAEC, Dhaka
S. C. Das, N. T. Dina, T. Saha, M. Moniruzzaman, M. Rajib, F. Deebea, M. Z. Kabir, M. G. Rasul	5th Young Scientist Congress	Bangladesh Academy of Science	25-27 November, 2022	Dhaka
Tumpa Saha	National Conference on Physics 2023	Bangladesh Physical Society	9-11 March 2023	Jahangirnagar University, Savar,

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

a) Special Research Grant (S&T)-

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, 2022-23 financed by Ministry of Science and Technology (MoST), Bangladesh.

Objective: To study the adsorption coefficient of both geological and construction materials to assess the migration of radioactive tracer.

b) Coordinated Research Proposal (CRP)-

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 explore and analyze various radioactive and rare earth containing minerals from different geological environment of Bangladesh.

INSTITUTE OF NUCLEAR MEDICAL PHYSICS INSTITUTE (INMP), AERE

Introduction

The global rise in the number of cancer patients is a concerning issue, and Bangladesh is no exception. In response to this challenge, the establishment of a dedicated cancer research institute was initiated in 2013 and subsequently developed into a fully functional institution by 2018. The Institute of Nuclear Medical Physics (INMP) is committed to delivering standardized and affordable treatment services while conducting cutting-

edge research in the field of this formidable disease. The institute also focuses on nurturing skilled professionals, including Nuclear Medical Physicists and Technologists, through comprehensive academic and practical training programs.

Currently, INMP provides cancer treatment using state-of-the-art Radiotherapy technology with a high-quality LINAC machine. Additionally, diagnostic procedures such as PET-CT and Ultrasound are utilized. The collaborative efforts of scientists, engineers, and doctors at INMP have fostered a multidisciplinary research environment covering various aspects of cancer treatment. Each year, a significant number of research articles are published in high-impact factor journals worldwide. Moreover, research collaboration with groups of students from different universities in Bangladesh remains ongoing throughout the year.

Objective

The prime objectives of INMP are as follows -

- To provide patient services for cancer detection and radiotherapy using medical physics techniques.
- To cultivate skilled radiation oncologists, medical physicists, and technologists through comprehensive academic and specialized training.
- To establish a Cyclotron facility for isotope production, MRI capabilities, and Brachytherapy facilities to support clinical applications 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. Research and Development Work(s)

Scientific Routine Activities : Quality Control (QC)

Name of item	Quality control (QC)	Times	By using
LINAC	Absolute Dosimetry	2	Water phantom
	Relative Dosimetry	1	3D water phantom
PET CT	Air Calibration of CT	57	-
	Image Quality of CT	57	CAT phantom
	PET QC	188	²² Na source

2. Manpower Development

Sl. No.	Title (training program/workshop/seminar/ symposium/ conference)	Date	Place	No. of participant
a)	Workshop on Monte Carlo Simulation for Medical Physics Application	13-14/02/2023	INMP	46
b)	In-house Seminar : (1 hour/presentation)	02/08/2022- 25/06/2023	INMP, AERE	Presenters: 16

3. Seminar/Symposium/Conference/Workshop/Meeting Attended

Name of the participant	Title of the event	Organizer	Date	Place
Dr. M Rafiqul Islam Director and PSO	4IR related tools and technology adaptation to conquer its challenges	SID, BAEC	23 Jan 2023	SID, BAEC
Dr. M Rafiqul Islam Director and PSO	Training on Right to Information, Grievance Redressal and Service Delivery Commitment	SID, BAEC	8 Dec 2022	SID, BAEC
Dr. M Rafiqul Islam Director and PSO	E-Nothi Office Management Training	ICS, AERE, BAEC	8-12 Jan 2023	ICS, AERE, BAEC
Dr. M Rafiqul Islam	Seminar-Workshop on Basics of Radiation Protection and Radiotherapy	SSDL, BAEC	21-22	SSDL,

Name of the participant	Title of the event	Organizer	Date	Place
Director and PSO, Md. Masud Parvej (SSO), Md. Abul Hasnat (SO)	Dosimetry		Mar, 2023	AERE
Dr. M Rafiqul Islam Director and PSO, Mst. Sarmin Sultana (SO)	Seminar- Workshop on the application of radiation in medicine	SSDL, BAEC	31 May-01 June, 2023	SSDL, AERE
Md. Masud Parvej (SSO)	Virtual Regional Training Course on Quality Management and QA in Radiotherapy Medical Physics	IAEA	12, Sep to 14, Oct, 2022	Virtual
Md. Masud Parvej (SSO)	Training Course on PPR-2008 and Public Procurement Management - 2022	TI, BAEC	10-20, Oct, 2022	TI, AERE
Md. Masud Parvej (SSO)	'Right to Information', 'Grievance Redressal Mechanism & GRS software, Service Delivery Commitment	BAEC	29, Sep, 2022	BAEC H.O.
Rayhan Alam (SO)	Follow-up training course on “Nuclear and Radiological Emergency Preparedness”;	BAEC-JAEA	04-15 Dec, 2022	TI, BAEC
Rayhan Alam (SO)	Follow-up training course on “Reactor Engineering”	BAEC-JAEA	12 Feb-2 Mar, 2023	TI, BAEC
Abdur Rahim, Md. Abul Hasnat	Training on “LINAC Commissioning”	TMSS Cancer Center, Bogura	29-31 July 2022	Bogura
All Officers of INMP	Workshop on Monte Carlo Simulation for Medical Physics Application	INMP, AERE	13-14 Feb. 2023	INMP

4. Others

- Md. Rafiqul Islam, PSO has completed in PhD. program in Japan on Oct, 2022.
- Dr. Sharmin Akter (MO) has completed the Post-Graduation in clinical pathology, BUP, DGMS on 1st March, 2023
- Dr. Jakir Hosen has started MD course in Oncology on March, 2023.

5. Service Rendered

Sl. No.	Name of service provided		Number/quantity of /patient/service	Revenue income (if any)
a	PET Scan		824	2,05,00,000/-
b	CT-Simulation		42	29,400/-
c	3D CRT	Plan	40	2,10,200/-
		Fraction	811	
d	Patient Review		40	8,000/-
e	USG		25	1,100/-
f	Training (SCMP)		(14 Students, 1year)	1,63,980/-
g	Training (Honorary)		(1 Student, 3 months)	6,000/-
	Return money (to radiotherapy patients for their uncompleted treatment due to LINAC problem.)		15 Patients, Remaining Fraction-149	-29,800/-
Total = (Two Core Eight Lakh Ninety Seven Thousand Eighty Hundred Eighty Taka only) =				2,08,977,880/-

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.
- Routine laboratory and plant processing of placer sands; processing and 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.
- Study on marine and coastal environmental radioactivity.
- Laboratory enrichment of radioactive mineral (i.e. Monazite) and quantification of radioactivity.
- Providing research support and industrial training to academic and professional organizations.

Activities**1. Research and Development Work(s)****1.1 Economic Minerals Exploration in Sonadia Island, Moheshkhali, Cox's Bazar.**

M.M.Karim, M.F.Hossain and M. M. Islam

A base line geological survey was conducted along eastern and western coast of Sonadia island, Moheshkhali, Cox's Bazar. Total 16 (sixteen) raw sand samples of 2 kg each were collected from surface to one meter depth. Objective of the study to separate heavy and light minerals from the bulk sand and identify valuable minerals. Samples are being processed in laboratory for heavy liquid separation to ready for microscopic analysis.

1.2 A Comparison between Present and Past Physical Situation of Badarmokam Deposits, Shaporirdwip, Teknaf.

M. M. Karim, M. F. Hossain and M. M. Islam

Badarmokam heavy minerals deposits are very vulnerable in terms of cyclone. Many of the area were under gone in to sea water after successive cyclone. A base line geological survey was conducted throughout Shahporirdwip area to assess present physical situation of minerals deposits compare to previous data. Total 12 (twelve) samples were collected from 12 different location from surface to 5 feet depth. Samples are being processed in laboratory for detail analysis.

1.3 Heavy Minerals Separation from the Sample of Dupitila Formation using HLS Tectique.

M. M. Karim, M. F. Hossain and M. M. Islam

15 raw sample of Dupitila formation from Sylhet Hill region has been processed, separated and analyzed. Sample was provided by Department of Petroleum and Mining engineering, Shajalal University of engineering and technology. Average percentage of heavy minerals in the sample is 1.56, where highest percentage value is 10.83 and lowest percentage value is 0.07.

2. Repair, Maintenance and Renovation work(s)

- Repaired broken part of wall and roof of few rooms of the office building and repair cleavage of the roof-top of the office building.
- Painting on the repaired portion of the office building.
- Repaired two book shelf of seminar room.

3. Manpower Development

Sl. No.	Title (arranged training program/workshop/seminar/symposium/conference)	Date	Place	No. of participants
a)	শুদ্ধাচার কৌশল কর্ম-পরিকল্পনা বিষয়ক প্রশিক্ষণ	18.09.2022	Seminar Room, BSMEC	10

4. Seminar/Symposium/Conference/Workshop/Meeting Attended

Name of the participant	Title of the event	Organizer	Date	Place
Md. MasudKarim	Regional Workshop for the Harmonization of Operational Protocols for the Collection, Identification and Counting of Microplastics in the Selected Matrices.	International Atomic Energy agency (IAEA) and Office of Atoms for Peace (OAP), Thailand	24-28 April, 2023	Pattaya, Thailand
Md. MasudKarim	International Conference on Environmental Protection for Sustainable Development	Faculty of Earth and Environmental Science, DU.	02-04 September, 2022	Dhaka University
Md. FahadHossain				

ATOMIC ENERGY CENTRE (AEC), CHATTOGRAM**Objective**

- Ensure the safety of food and environment from radioactive contamination.
- Monitoring and assessing pollution levels in marine and coastal environments due to nuclear activities or radioactive waste disposal.
- Promote research and development activities on environmental issues.
- Expand cooperation with other scientific organizations, universities, and 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.

Activities**1. Research and Development Work(s)****1.1 Research Title: Assessment of Natural Radioactivity Concentration in Surface Soil of Rangamati District by Measuring Activity Concentration of Natural Radionuclides and Radiological Hazard.**

S. Hossain, AKM S. I. Bhuian, S. Das, M. Debnath and N. S. Resma

Abstract: Depending on natural radioactive isotopes present in an area, humans or plants are exposed to natural radioactivity at different levels. When present in the climate, these radionuclides, regardless of whether natural or artificial are accessible for take-up by plants and humans and enters the food chain, which influence human both directly and indirectly. There were 4 international and 53 local research articles on radiological measurements reviewed in this study. After reviewing these 53 local research articles on environmental measurements, it has been found that, there is no detailed study of natural radioactivity of soils of Rangamati District. Perhaps, a very small amount of discrete data is found which is not enough to define the radiological parameters of largest district of Bangladesh, Rangamati. 33 sub-surface soil is collected from the accessible places of Rangamati for the analysis along the 5-10km range. The results of natural radionuclide (^{226}Ra , ^{232}Th , and ^{40}K) concentration of the collected soil samples at the surface of Rangamati districts are analyzed and a comparative study is plotted. The activity concentrations of the radionuclides ^{226}Ra , ^{232}Th , and ^{40}K were ranged from 8.0 ± 2.0 Bq/kg to 21 ± 3.15 Bq/kg for ^{226}Ra with an average of 14.14 ± 3.05 Bq/kg, from 21 ± 5.46 Bq/kg to 47 ± 11.75 Bq/kg for ^{232}Th with an average of 36.22 ± 8.85 Bq/kg, and from 137 ± 15.07 Bq/kg to 550 ± 99.0 Bq/kg for ^{40}K with an average of 338.52 ± 28.87 Bq/kg. The calculated average of radionuclides ^{226}Ra , ^{232}Th , and ^{40}K in this study were 14.14 ± 3.05 Bq/kg, 36.22 ± 8.85 Bq/kg, and 338.52 ± 28.87 Bq/kg, respectively which were within the world average values 33 Bq/kg for ^{226}Ra , 45 Bq/kg for ^{232}Th , and 420 Bq/kg for ^{40}K , respectively according to UNSCEAR 2008. The radium equivalent activity in the soil samples was found in the range of 56.44 ± 11.69 Bq/kg to 126.56 ± 22.59 Bq/kg with an average of 92.30 ± 17.93 Bq/kg, which is lower than the world average standard value 370 Bq/kg (UNSCEAR 2008). The absorbed gamma dose rates due to the radionuclides in soil at 1m above from the ground level were also calculated. The absorbed dose rate was found in the range of 26.20 ± 5.21 nGy/h to 59.18 ± 10.92 nGy/h with an average of 42.52 ± 7.75 nGy/h, which is lower than the world average value. Annual effective dose rates found to be ranged from 0.032 ± 0.01 mSv/y to 0.073 ± 0.01 mSv/y with an average of 0.052 ± 0.01 mSv/y. The value of

annual effective dose rate in the present study is lower than the world average value of 0.48 mSv/y. This confirms that all of these research areas at a safe level for public health. The calculated values of representative level index found to be ranged from 0.35 ± 0.08 Bq/kg to 0.97 ± 0.17 Bq/kg with an average of 0.68 ± 0.13 Bq/kg. In 3 soil samples, the calculated values of representative level index are close to 1, which implies that these soil samples should be avoided and not used in agriculture or in building materials. The outcomes of this study could serve as important baseline radiological data for future research studies and environmental monitoring.

1.2 Research Title: Present Status of Heavy Metal Concentration in Soil of Halda River, Chattogram, Bangladesh.

S. Hossain, C. K. Mahmud and R. Roy

Abstract: The present study aimed to investigate the concentration of heavy metals in the soil of Halda. Sediment samples were collected from six different spots for four seasons. The samples were analyzed for six heavy metals (Pb, Cr, Zn, Mn, Cu, Cd) by Atomic Absorption Spectrometry. The mean concentration of the metals was: Pb- (14.28 ± 1.13), Cr- (22.9 ± 2.32), Zn- (47.47 ± 6.03), Mn- (776.39 ± 129.88), Cu- (19.21 ± 2.21) and Cd- (0.03 ± 0.01) mg/kg respectively. Seasonal variation, geo accumulation (I-geo), contamination factor (CF), risk index (RI), and pollution load index (PLI) of the metals were also assessed. The result of I-geo values for Pb, Cr, Zn, Mn and Cd showed that the sediment quality varied from unpolluted to moderately polluted. CF and Er values of Pb, Mn and Cu showed considerable and moderate contamination, while Cr, Zn and Cd showed low contamination. RI value of all metals indicated low risk while PLI value of sampling sites showed no presence of pollution.

1.3 Research Title: Assessment of Heavy Metals Contamination in Water of Halda River; a Unique Carp Fish Breeding Area of Bangladesh

S. Hossain, C. K. Mahmud, and R. Roy

Abstract: The present study aimed to assess the contamination level of heavy metals viz (Cr, Cu, Cd, Fe, Zn, Pb) in the water of Halda River, Chittagong, Bangladesh. For the study, samples were collected from six sampling sites for four seasons and analyzed by the Atomic Absorption Spectrophotometer (AAS). The order of mean concentrations of heavy metals was Fe (91.295 ± 64.699) > Pb (0.334 ± 0.061) > Zn (0.247 ± 0.142) > Cu (0.062 ± 0.026) > Cr (0.117 ± 0.076) > Cd (0.012 ± 0.061) mg/L. The concentrations of Cr, Cd, Fe and Pb in river water were significantly higher than the WHO permissible limit and Cr, Cu, Cd, Pb and Zn concentrations were higher than USEPA (2006) limit. Moderate seasonal variations were found among the analyzed metals and the calculated mean concentrations of heavy metals for the four seasons follow the trends: dry season 1 (21.99) > wet season 2 (18.01) > dry season 2 (17.50) > wet season 1 (16.08) mg/L. To assess the favorability of breeding environment for Carp fishes, different contamination indices such as Degree of Contamination (Cdeg), Ecological Risk assessment (Er), Risk Index (RI), Pollution Load Index (PLI), Heavy metal Pollution Index (HPI) were analyzed. The results showed that all the sampling sites have high degree of contamination ($24 < \text{Cdeg}$) and the analysis of Risk index indicated that the water from the sampling points varied from moderate to high risk. The values for pollution load index (PLI) for all the sampling sites were found higher than 1 indicating pollution of the sampling sites. The mean HPI value for all the sampling sites were found higher than the Critical Index limit 100, hence point out the fact that water quality is degraded because of Heavy metal contamination.

1.4 Research Title: Study on Evaluation of Trace Elements in RIPARIAN Vegetation of Halda River, Chattogram, Bangladesh.

N. Deb, C. K. Mahmud, and R. Roy

Abstract: The study aimed to evaluate the selected heavy metal concentration (mg/kg) of riparian vegetation collected from six different spots of Halda River, Chittagong at four different seasons. Seasonal variation of heavy metals was analyzed and accumulation of heavy metals at different spots was calculated. This research was conducted from September 2021 to November 2022 on six important points of Halda River. Total twenty-four samples were collected. Concentration of six heavy metals i.e, three essentials (Cu, Fe, Zn) and three non-essentials (Cr, Cd, Pb) were measured. Leaves, trunks, roots were collected as samples from different plants. Heavy metal analysis was done by FAAS (Flame Atomic Absorption Spectroscopy). Results showed that bioaccumulation of metals were higher than standard values. Results also disclosed that heavy metal accumulation was higher in dry season than in wet season. Khandokia Khal was densely polluted spot among

all studied spots. The order of concentration of heavy metals in plant samples was $\text{Fe} > \text{Zn} > \text{Cu} > \text{Cr} > \text{Pb} > \text{Cd}$ with their values of 3455.424 ± 1572.307 , 23.372 ± 4.181 , 18.520 ± 3.656 , 14.628 ± 6.926 , 4.112 ± 2.373 , 0.065 ± 0.014 mg/kg. Among six heavy metals in plant samples, accumulation of Fe was maximum, and accumulation of Cd was minimum. Few collected plant samples of this research were edible by cattle and human. All metals were much more than the permissible limits of WHO which mean that there was high risk of health problems by continuous consumption of these contaminated plant species of the Halda River. This data can be used as a baseline data for further study.

1.5 Research Title: Evaluation of Toxic Metals Contamination in Fishes of Halda River - An Approach towards Risk Assessment

N. Deb, C. K. Mahmud, and R. Roy

Abstract: The study aimed to evaluate the degree of selected heavy metal concentration including Chromium (Cr), Zinc (Zn), Lead (Pb), Cadmium (Cd), Iron (Fe) and Manganese (Mn) along with the possible human health risk in three fish samples (*Setipinnaphasa*, *Apocryptesbato*, *Macrobrachiumrosenbergii*) of Halda river, Bangladesh. This species were the most consuming fishes by local people. Fish samples were collected three months interval from September 2021 to June 2022. Atomic Absorption Spectrophotometry technique used to measure the average concentration of selected metals which follow the trends of $\text{Fe} > \text{Zn} > \text{Mn} > \text{Cr} > \text{Pb} > \text{Cd}$. The metal concentration in fishes were found to be comparatively higher in most of the sample than the permissible limit stated by international organization such as WHO, which indicates the elevated pollution level of Halda river. To evaluate potential risks to human health associated with Halda fish consumption, Estimated Daily Intake (EDI), Target Hazard Quotient (THQ), Hazard Index (HI), Target Risk of Cancer (TR) were also calculated. With the assumption that people (62 year average aged) consumed fish 62.58g/person/day (as per MOFL 2017-18) the EDI, THQ, HI, TR were calculated and compared with the permissible safety limit. The THQ value was less than 1 which indicated no health risk to adult. The obtained HI value is less than 1 indicating there is no health hazards to the local consumer. In addition to this, the TR values were within the range to that reveal no incremental probability of an individual to develop cancer over a life time exposure (72 year). However, long term consumption might cause risk to stimulate cancer.

1.6 Research Title: Measurement of Heavy Metals Concentration and Associated Health Risk in the Soil of Cumilla District Systematic Gridding Method.

AKM S. I. Bhuiyan, N. Deb, Chowdhury K. Mahmud and R. Roy

Abstract: Concentrations of heavy metal in environmental element like soil are a great concern for health issues of inhabitants. For monitoring and assessing the risk it is necessary to measure the concentrations frequently and systematically since the concentrations can be varied time to time with different natural and man-made activities. Researchers are measuring the heavy metal concentrations in Bangladesh since several decades. In this study, for the first time we accumulated all the previously measured data and the location of sampling for those studies. After gathering all these locations, we found that very few places were studied for heavy metal concentrations of Bangladesh. Most of the places remain unmeasured. Among unmeasured place we decided to collect sample from Cumilla district by using systematic gridding method, so that in future researchers can conduct study on other places. This study investigated the concentration of heavy metals in soil samples collected from Cumilla District using atomic absorption spectrophotometry (AAS). The analysis focused on six heavy metals, namely lead (Pb), cadmium (Cd), copper (Cu), zinc (Zn), nickel (Ni), and chromium (Cr). The results showed that the concentrations of these heavy metals in the soil samples varied considerably, with Ni and Cu exhibiting the highest concentrations and Cd exhibiting the lowest concentrations, almost below the detection limit. The mean concentrations of Ni and Cu were found to be 1.359 mg/Kg and 0.800 mg/kg, respectively. The maximum concentration of Ni detected in the soil samples was 3.081 mg/kg, which exceeded the safe limit set by regulatory agencies. After measuring the concentrations of heavy metal, the spatial distribution of heavy metals in the soil samples has been drawn which showed that the highest concentrations were found in Nagari Para, Cumilla (CoSs-52). The results suggest that the soil in Nagari Para, Cumilla is contaminated with heavy metals due to various process such as Sewage sludge that is used as fertilizer can contain high levels of nickel, leading to soil contamination and deposited onto soil through air pollution, which may pose a potential risk to human health and the environment. The result shows that the concentration of heavy metals in Cumilla district is comparably less than divisional district, specially from Dhaka. And also, from most other countries worldwide. Specially no cadmium was detected in the study

area. Still there were some contaminations. The maximum concentration of Cr is 1.468 mg/Kg at Yousuf Nagar, Cumilla and the minimum concentration of Cr is 0.461 mg/Kg at Saldanodi, Cumilla. the maximum concentration of Ni is 3.081 mg/Kg at Nagari Para, Cumilla and the minimum concentration of Ni is 0.711 mg/Kg at Saldanodi, Cumilla. the maximum concentration of Cu is 1.473 mg/Kg at Nagari Para, Cumilla and the minimum concentration of Cu is 0.295 mg/Kg at Gayaspur, Cumilla., the maximum concentration of Zn is 0.087 mg/Kg at Baynagar, Cumilla and the minimum concentration of Zn is 0.02 mg/Kg at Kutumpur Bazar, Cumilla the maximum concentration of Pb is 1.03 mg/Kg at Kutumpur Bazar, Cumilla and the minimum concentration of Pb is 0.248 mg/Kg at Kalisema, Cumilla, the maximum concentration of Cd is -0.05 mg/Kg at Barair, Namtola, Cumilla and the minimum concentration of Cd is -0.071 mg/Kg at Kutumpur Bazar, Cumilla. Therefore, effective measures should be taken to control heavy metal pollution and protect the soil quality in the study area

2. Manpower Development

(Arranged Training program /Arranged Workshop /Arranged Seminar /Arranged Symposium /Arranged Conference)

Sl. No.	Title (training program/workshop/seminar/ symposium/ conference)	Date	Place	No. of participants
a)	Training on “National Integrity Strategy”.	12 th Sep 2022 05 th Dec 2022 21 th May 2022	AECC, BAEC	25
b)	Training on "Right to Information"	06 th Nov 2022	AECC, BAEC	25
c)	পরমাণু শক্তি কেন্দ্র, চট্টগ্রামের সেবাপ্রদানের নিমিত্তে তথ্যপ্রযুক্তির ব্যবহার সম্পর্কিত সেমিনার	19 th Jun 2023	AECC, BAEC	20

3. Seminar/Symposium/Conference/Workshop/Meeting Attended

Name of the participant	Title of the event	Organizer	Date	Place
Dr. Shahadat Hossain	Regional Workshop for the Harmonization of Operational Protocol for the collection, Identification and Counting of Microplastic in the selected Matrices	IAEA	(24 th -28 th) April, 2023	Pattaya, Thailand
	বাংলাদেশ সমুদ্রবিজ্ঞান শিক্ষা ও গবেষণার ৫০ বছর	বাংলাদেশ ওশানোগ্রাফিক রিসার্চ ইনস্টিটিউট এবং ওশানোগ্রাফি বিভাগ, চবি।	(10-11) th February 2023	Cox Bazar, Ctg.
	Final Project review meeting	IAEA	(06-12) th Nov, 2022	Singapore
Nighat Sultana Resma	তথ্য অধিকার, অভিযোগ প্রতিকার ব্যবস্থা ও জিআরএস সফটওয়্যার এবং সেবা প্রদান প্রতিশ্রুতি বিষয়ক প্রশিক্ষণ	SID, BAEC.	08 th December 2022	Online Training Course
	Webinar on “Connectivity of Scintillation Sensor”.	IAEA	18 th April 2023	Online Training Course
Manish Debnath	Training on fallout radionuclide	IAEA		AECD,
Rashmi Roy	তথ্য অধিকার, অভিযোগ প্রতিকার ব্যবস্থা ও জিআরএস সফটওয়্যার এবং সেবা প্রদান প্রতিশ্রুতি বিষয়ক প্রশিক্ষণ	SID, BAEC.	29 th Sep 2022	Online Training Course

Name of the participant	Title of the event	Organizer	Date	Place
	এসডিজি বাস্তবায়ন সংক্রান্ত সমসাময়িক বিষয়ে লার্নিংসেশন/ কমশালা	SID, BAEC.	19 th Dec 2022	Online Training Course
	Webinar on “Connectivity of Scintillation Sensor”.	IAEA	18 th April 2023	Online Training Course
Md. Shihabur Rahman Bhuiyan.	চাকুরীর আচরণবিধি ও নিয়ম শৃংখলা সংক্রান্ত প্রশিক্ষণ ও কোর্স	TI, Savar AERE.	20 th -22th June, 2023	TI, Savar AERE.
Rajib Chakma	চাকুরীর আচরণবিধি ও নিয়ম শৃংখলা সংক্রান্ত প্রশিক্ষণ ও কোর্স	TI, Savar AERE.	20 th -22th June, 2023	TI, Savar AERE.

4. Stakeholder Meeting

Stakeholder meetings and one E-learning session were arranged at the Atomic Energy Centre, Chattogram on 04th September 2022, 13th October, and 22nd November 2022.

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

- IAEA/CRP Project-JO2005: Improvement of the Assessment of Initial Alarms of Radiation Detection Instruments. (Objective: Develop technical documents and tools that can be used by FLOs and expert organizations to enhance Member States’ ability to make high-confidence assessments on whether nuclear and other radioactive material out of regulatory control is present when an initial alarm occurs.)
- IAEA-Non-RCA Project RAS7038: Monitoring of the Marine Environment for enhanced understanding of the abundance and impact of Marine Plastic Pollution (RAS7038)”.
- S&T Project-Comparative study of natural radioactivity content in tiles made in Bangladesh and imported from abroad (SRG-223435).
- S&T Project-Spatial Distribution of absorbed dose of radiation and heavy metal concentration in soil of Chandpur and Cumilla district of Bangladesh and resultant health hazards (SRG-223434).

6. Service Rendered

Sl. No.	Name of service provided	Number of sample/consignments	Revenue income (TK)
a)	Radioactivity testing of imported food and allied materials	16775	277,503,360/-
b)	Radiation Inspection service of EFT/ Steel Dust at different industries.	26	208,650/-

2. Others

a) Tertiary inspection of Stainless-Steel melting Scrap materials (Container no: BSIU-2781810 X 20) of SS Corporation, Shitalpur, Sitakhunda Chattogram- 4314 was carried out on 22-01-23 at Chittagong port.

Members of the inspection team: AKM Saiful Islam Bhuiyan, Ponkoj Das, Md. Mozamel Hoque.

b) Tertiary inspection of Stainless-steel melting scrap material (Container no: CLHU-2923890 X 20) of OT Metal Steel Pvt. Ltd. Hakkani Airon market, Sagorika Road, BSCIC E/A, Pahartoli Chattogram- 4202. Was carried out on 04-03-23 at Chittagong Port.

Members of the inspection team: AKM Saiful Islam Bhuiyan, Josim Uddin, Md. Omar Faruk.

c) Tertiary inspection of Ferrous waste and scrap consisting of HMSI (Container No: MEDU-2629485 X 20, TEMU-4386155 X 20 and MEDU-3812422 X 20) of Elite Iron and Steel Industries Ltd. 1009, Bade Kalmeswar, Gazipur, Dhaka was carried on 01-04-23 at Chittagong Port.

Members of the inspection team: AKM Saiful Islam Bhuiyan, Md. Mozamel Hoque, RajeshBarua.

d) Tertiary inspection of Zinc wastes and scrap materials (Container no: TCLU-3430214 X 20, MOAU-6763646 X 20 and FCIU-3016546 X 20) of All Trade International, South Land Centre, Agrabad was carried out on 04/09/2022 at Chattogram Port.

Members of the inspection team: Shahadat Hossain, Sopan Das, Md. Mozamel Hoque, RajeshBarua.

e) Tertiary inspection of Stainless-Steel melting Scrap materials (Container no: TCKU-1130674 X 20) of SS Corporation, ShitalpurSitakhunda, Chattogram- 4314 was carried out on 04-09-22 at Chittagong port.

Members of the inspection team: Shahadat Hossain, Sopan Das, Md. Mozamel Hoque, RajeshBarua.

f) Tertiary inspection of Stainless-Steel melting Scrap materials (Container no: TCLU-3430214 X 20, FCIU-3016546 X 20, MOAU-6763646 X 20 and CAIU-2836250 X 20) of SS Corporation, ShitalpurSitakhunda, Chattogram- 4314 was carried out on 04-09-22 at Chittagong port.

Members of the inspection team: Shahadat Hossain, Sopan Das, Md. Mozamel Hoque, RajeshBarua.

g) Recovery of radioactive material or source (Container no: TCLU-3608878 X 20, TRHU- 2075208 X 20, NYKU- 3827413 X 20 and CAIU-2836250 X 20) of ALL Trade International, South Land Centre, Agrabad was carried out on 13/12/2022 at Eastern Logistics Depot Ltd Chattogram.

Members of the inspection team: AKM Saiful Islam Bhuiyan.

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.

Activities

1. Seminar/Symposium/Conference/Workshop/Meeting Attended

Name of the participant	Title of the event	Organizer	Date	Place
Mithun Chandra Bhakto	The 42 nd Understanding Training on ISO/IEC 17025: 2017	BAB	29-31 August 2022	NPO Seminar Hall, Annex Building of the Ministry of Industries, 91, Motijheel C/A, Dhaka-1000
	Training on Reactor Engineering Course	BAEC	12 Feb. to 02 March, 2023	Training Institute, AERE, Savar, Dhaka

2. Service Rendered

Sl. No.	Name of service provided	Number/quantity of sample/patient/service	Revenue income
a	Sample Analysis (imported food sample)	26	4,94,928/-
Total			4,94,928/-

II. BIO-SCIENCES

INSTITUTE OF FOOD AND RADIATION BIOLOGY (IFRB), AERE

Agrochemical and Environmental Research Division, IFRB

Objective

Agrochemical and Environmental Research Division (AERD) is involved in research relating to residues fate, distribution, degradation, translocation and impact of pesticides in environment and also engaged in elemental analysis and their impact on food & environment and in rendering services. 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

Activities

1. Research and Development Work(s)

1.1 Assessment of the Embryotoxic Potential of Contaminated Sediments using Fish Embryotoxicity Tests for the River Buriganga, Dhaka, Bangladesh

Z. Fardous, M.A. Rahman, M.Nesha and M.A.Z. Chowdhury

Sediment samples from six different locations of Buriganga River following exposure to Zebrafish (*Danio rerio*) eggs and larvae displayed prominent effects on both whole sediments and sediment organic extracts. The acute and sublethal effects during 96 h exposure period included (i) a significant ($P < 0.05$) increase in mortality and abnormalities in zebrafish eggs and embryos; (ii) a significant ($P < 0.05$) reduction in hatching success and heart rate; (iii) increased frequency of helical tail and lordosis after 96 h exposure to sediment extracts; (iv) developmental delay and yolk sac edema after exposed to whole sediments at 96h exposure period. Chemical analysis showed the increased concentrations of heavy metals (Zn, Cr, Cu, Pb, and Cd) in downstream (S1, S2, and S3) compared to upstream (S4, S5, and S6), where some ions such as Cd and Cr exceeded the Environmental Protection Agency's Threshold Effect Level (EPA TEL). The current study delineates the contamination of extremely toxic compounds in the sediment of Buriganga River, which may initiate toxic effects on the early life stages of fish. Therefore, integrating zebrafish embryo toxicity tests may be crucial for evaluating the sediment quality of polluted river.

1.2 Human Health Risk Assessment of Edible Body Parts of Chicken through Heavy Metals and Trace Elements Quantitative Analysis.

M. Nesha, Z. Fardous, M.A. Rahman and M.A.Z. Chowdhury

Food safety and security have now been regarded as a significant emerging area within the food supply chain leading to scientific and public health concerns in the global world. The poultry sector is a substantial threat to heavy metal intoxication for Bangladeshi people due to contaminated drinking water and feed sources, as well as the poultry sector's surrounding environment and soil. This study was carried out to ascertain the residual concentrations of heavy metals (Pb, Cd) and trace elements (Cr, Fe, Cu, and Zn) in various edible chicken body parts (breast, liver, gizzard, heart, kidney, and brain) to observe the quality of the consumed chickens and to assess public health risk. Atomic absorption spectrometry (AAS) was used to check the content of toxic heavy metals and trace elements in 108 samples of 18 broiler chickens collected from six different locations of Dhaka North City Corporation markets in Bangladesh. The measured concentrations (mg/kg fresh weight) ranged from 0.33 ± 0.2 to 4.6 ± 0.4 , 0.004 ± 0.0 to 0.125 ± 0.2 , 0.006 ± 0.0 to 0.94 ± 0.4 , 4.05 ± 4.2 to 92.31 ± 48.8 , 0.67 ± 0.006 to 4.15 ± 2.7 , and 4.45 ± 0.62 to 23.75 ± 4.3 , for Pb, Cd, Cr, Fe, Cu, and Zn respectively. Except for Pb and Cu most of the investigated heavy metals and trace element levels in chickens were lower than the maximum allowable concentration (MAC) set by FAO/WHO and other regulatory agencies. The estimated level of Pb was nearly six times higher in the chicken brain. The estimated daily intake (EDI) values for all the studied metals were below the preliminary tolerated daily intake (PTDI). The target hazard quotient (THQ) values of the broiler chicken meat samples varied for adults and children, and the range was found to be 0.037–

0.073 for Pb, 0.007–0.01 for Cd, 0.0–0.08 for Cr, 0.002–0.004 for Fe, for 0.00–0.002 Cu, and 0.004–0.008 for Zn, not exceeding the maximum level of 1 according to USEPA. The calculated THQ and total target hazard quotient (TTHQ) values were measured at less than one, suggesting that the consumption of chicken meat has no carcinogenic danger to its consumers. The Target carcinogenic risks (TCRs) of Pb, Cd, Cr, and Cu were within acceptable limits. The TCR values for children were, to some extent, higher than that of adults, which proposes that regular monitoring of both harmful and essential elements in chicken samples is necessary to determine whether or not any possible health risk to consumers exists. In terms of health, this study demonstrated that consumers are chronically exposed to elemental contamination with carcinogenic and non-carcinogenic effects

1.3 Investigation of Some Physicochemical Parameters and Heavy Metals for Monitoring the Groundwater Quality of Savar Upazila of Dhaka, Bangladesh.

M. Nesha, Z. Fardous, M.A. Rahman and M.A.Z. Chowdhury

Safe and clean water is an indispensable component for all kinds of living beings. An attempt was taken to examine the drinking water, particularly the groundwater quality of Savar Upazila under the Dhaka District of Bangladesh by assessing some physicochemical parameters such as pH, total dissolved solids (TDS), electrical conductivity (EC), and temperature and the levels of different heavy metals (Cu, Cd, Cr, Fe, Mn, and Zn). To measure the concentration of the six selected metals from the groundwater samples collected from 38 different locations of Savar Upazila, Atomic Absorption Spectrophotometry (AAS) was used. Our results showed that the pH, TDS, EC, and temperature ranged from (6.56-7.72), (73-437 mg/L), (117-654 μ S/cm), and (27.7-30.5°C), respectively which were found within the limit of water standards recommended by national and global regulatory authorities. The mean concentration of different studied metals in the reported water samples of Savar Upazila followed the order of Fe > Zn > Mn > Cr > Cu > Cd. The average concentration was 0.136 ± 0.188 mg/L, 0.121 ± 0.289 mg/L, 0.033 ± 0.060 mg/L, 0.015 ± 0.0096 mg/L, 0.0104 ± 0.005 mg/L, and 0.0022 ± 0.0019 mg/L for Fe, Zn, Mn, Cr, Cu, and Cd, respectively. In this study, Water quality index (WQI) was also calculated for the studied samples and it was observed that the groundwater of Savar Upazila belonged in the good to excellent categories and can be recommended as suitable for drinking purposes.

2. Seminar/Symposium/Conference/Workshop/Meeting

Name of the participant	Title of the event	Organizer	Date	Place
Zeenath Fardous	Environmental Radioactivity Monitoring course at BAEC 2023	BAEC & JAEA	15-19 January 2023	Training Institute, AERE
Meherun Nesha	E-nothi Office Management	BAEC	8-12 January 2023	

Food Safety and Quality Analysis Division, IFRB

Objective

Food Safety and Quality Analysis Division is basically involved in carrying out research on improvement of food safety (food fraud, adulteration, origin authentication, species identification etc.) and quality (nutritional, functional and microbiological quality) through conventional and nuclear technology. Research works of FSQAD also focus on development of convenience food and food additives from different kinds of food and food derivatives.

Activities

1. Research and Development Work(s)

1.1 Impact of Gamma Radiation, Potassium Sorbate and Low Temperature on Shrimp (*Penaeus monodon*) Preservation

Md. Shajadul Islam, Arzina Hossain, Mahfuza Islam, M. Kamruzzaman Munshi, Mohammad Shakhawat Hussain, Keshob Chandra Das, Irfan Ahmed, Md. Shafiqul Islam Khan, Roksana Huque

Description: 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 Characterization of Microplastic Pollution in the Pasur River of the Sundarbans Ecosystem (Bangladesh) with Emphasis on Water, Sediments and Fish

Nowshin Nawar, Md. Mostafizur Rahman, Farah Noshin Chowdhury, Shumayta Marzia, Mir Mohammad Ali, Md. Ahedul Akbor, Md. Abu Bakar Siddique, Mst. Afifa Khatun, Md. Shahjalal, Roksana Huque, Guilherme Malafaia

Description: An emerging concern of today's world, due to their universal dispersion worldwide, is the environment's microplastic pollution. The Sundarbans, the world's largest mangrove, have unique and dynamic environmental settings with numerous pollution risk exposures, including microplastics (MPs). Thus, the present study has focused on the MP pollution in water, sediment, and fish samples of the Sundarbans of Bangladesh for the first time. Water and sediment samples were collected ($n = 30$ /each) from sampling locations along the Pasur river (Bangladesh). Furthermore, nine species of fish samples were collected from a local fish market situated at the Mongla port. Results show that 100 % of the analyzed samples have evidence of MPs. On average, 2.66×10^3 plastic particles/L and 1.57×10^5 particles/kg were found in water and sediment samples, respectively. Furthermore, results show a higher number of MPs in the animals' gastrointestinal tract (GIT) (10.41 particles/g), concerning the average concentration recorded in the muscles (4.68 particles/g). *O. pama* and *H. nehereus* were the species that showed the highest MPs accumulation in the GIT. In the muscles, the highest MP levels were observed in *T. ilisha* and *L. calcarifer*. Most of the particles were smaller than 1 mm; black-colored particles dominated the pool. FT-IR analysis revealed the presence of seven polymer types where polyamide was abundant in water and sediment samples. SEM analysis showed morphological structures and adsorbed particles on the surface of plastic samples, and the spatial distribution of MPs indicates that the location with high human intervention has elevated levels of MPs. Therefore, our study demonstrates that Sundarbans mangrove forests are highly contaminated with MPs and that its fisheries can be a potential source of human exposure to these pollutants.

1.3 Microplastics in Different Fish and Shellfish Species in the Mangrove Estuary of Bangladesh and Evaluation of Human Exposure

Maisha Binte Sultan, Md. Mostafizur Rahman, Mst. Afifa Khatun, Md. Shahjalal, Md. Ahedul Akbor, Md. Abu Bakar Siddique, Roksana Huque, Guilherme Malafaia

Description: The water bodies in Bangladesh thrive from plastic pollution. Estuaries are pools of environmental contaminants, and the world's largest mangrove forest, Sundarbans' estuary, is no exception. Thus, for the first time, we investigate MPs abundance in the muscle and gastrointestinal tract (GIT) of twenty estuarine species of fish and shellfish of the Sundarbans, as well as the human health risk. MPs abundance was evident in all the samples ranging from 5.37 ± 1.07 to 54.30 ± 16.53 MP items/g wet body weight (dw) in muscle samples and 7.33 ± 1.89 to 205.61 ± 136.88 MP items/g (dw) in GIT samples. The estimated health risk from MPs is substantial, where the average human intake will be 85,710.08 items of MPs per year per capita for the population of Bangladesh. The dominant polymer types observed using ATR-FTIR are PP and PE (17.5 %), PA (17.5 %) in the muscle tissues, and PP and PE (11.11 %), and EVA (11.11 %) in the GITs. Bottom-feeding species, such as demersal and benthic species, are more contaminated. However, the level of MPs in the species shows a negative correlation with the length and weight of the species. This study reveals that MP pollution is widespread and concerning in Bangladesh's Sundarban mangrove estuarine zone.

2. Manpower Development

Sl. No.	Title (training program/ workshop/ seminar/ symposium/ conference)	Date	Place	No. of participant
a)	Regional training course on application of stable isotope techniques to assess protein quality of sustainable food sources for improving maternal & child nutrition in Asia	6-10 March, 2023	IAEA	2

3. Seminar/Symposium/Conference/ Workshop/Meeting Attended

Name of the participant	Title of the event	Organizer	Date	Place
Dr. Kamruzzaman Munshi	Meeting	IAEA	19-23 June, 2023	Geongeup, South Korea

4. Collaboration work (ADP/ FNCA/ MEXT/ FTC/ IAEA/ RCA/ TC/ S&T/ CRP/ In-house project, Universities, etc)**a) IAEA RCA project****Code:** RAS 6103

Title : Applying Stable Isotope Techniques to Assess Protein Quality of Sustainable Food Sources for the Improvement of Maternal and Child Nutrition

Description: Plant protein is a natural and major protein sources in the Asia-Pacific region. Daily per capita intake of plant protein has been reported to be 50-70% in Myanmar, Kuwait, Thailand, Vietnam, Pakistan and Indonesia. Globally, the increased preference for plant-based protein food sources includes the nutritive compositions (lower calories and fat, containing higher fiber and essential nutrients) compared to animal food sources. Production of plant protein also offers an environmental –friendly and sustainable solution due to the lower energy consumption, emissions, land usage and water consumption. This regional project will provide data on protein quality from plant-based or sustainable protein food sources in the Asia-Pacific region aiming at improving maternal and child nutrition and health.

b) IAEA RCA project**Code:** RAS 1028

Title: Improving the Quality Management Practices in Radiation Processing Facilities for Better Performance and Application

The works under this project are basically involved in providing gamma irradiation services to various government and non-government organizations in Bangladesh. The nuclear technique to be used in this project is radiation processing by Gamma ray facilities. Research works includes to promote export food, agricultural and medical products by irradiation technology; to develop and demonstrate irradiation technology for medical, pharmaceutical, packaging products as well as food commodities; to render irradiation services in research & development and commercial purposes; to run the research works of various research organizations smoothly and provide sterilization services for public healthcare in Bangladesh. The present study mainly focuses on determination of delivered irradiation dose of Research & Development (R&D) and commercial samples using different types of radiation dosimeters. In this case, Ceric-Cerous, Fricke, Amber-Perspex and Red- Perspex dosimeters are used for the determination of absorbed dose of irradiated samples. The implementation of quality management practices in radiation processing facilities could warrant the effectiveness and safety of nuclear science and technology that would contribute to sustainable development of the country.

5. Service Rendered

Sl. No.	Name of service provided	Number/quantity of sample/service	Revenue income in taka
1	Total Sugar	5	5000/-Taka
2	Calcium and Phosphorus	2	2000/- Taka
3	Protein	3	3000/- Taka
4	Protein, Iron, Lipid, Calcium	4	4500/- Taka
			Total = 14500/-Taka

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 20 different government (including institutes of BAEC) and private organizations at free of cost during July, 2022 to June, 2023. During this time period, GSD has rendered irradiation services to commercial products of 11 food industries and 46 medical and pharmaceutical companies of Bangladesh and earned 31,47,562/- revenue for the country. The radioactivity of the source was 1196.21 TBq (32.33 kCi) on 1st July, 2022 and 1047.655 TBq (28.315 kCi) on 30th June, 2023.

Activities**1. Research and Development Work(s)**

GSD has provided irradiation services for research purpose to various divisions/institutes of Bangladesh Atomic Energy Commission (BAEC), Bangladesh Agriculture Research Institute (BARI), Rajshahi University (RU), Dhaka University (DU), Khulna University (KU), UniMed UniHealth Pharmaceutical Ltd., Reneta Pharmaceutical Ltd., Al-Madina Pharmaceutical Ltd., Sharif Pharmaceutical Ltd., IBN Sina Pharmaceutical Ltd., Mawlana Bhasani Science & Technology University etc at free of cost during this time period. GSD provides irradiation service for research purpose to 159 food samples (rice seed, rice spike, wheat, mango, biscuit, java apple jelly, raw mango jelly, java apple, banana, potato, sweet potato, mascale seeds etc.) and 3,565 medical and pharmaceutical samples (Bone graft, bone chips, amnion graft, skull bone, scaffold, amniotic membrane, hydrogel, fexofenadine hydrochloride USP, chitosan, gelatin film etc.).

2. Commercial activities

GSD rendered commercial sterilization services to 53 different pharmaceuticals, medical, food processing and manufacturing, supplier companies during this service time period. The names pharmaceutical and medical companies are: The ACME laboratories Ltd, General Pharma Ltd, Polycon Ltd, Aristopharma Ltd., IBN Sina Pharma Ltd., Apex Pharma Ltd., Popular Pharma Ltd., Square Pharmaceuticals Ltd., Ziska Pharmaceuticals Ltd., Team Pharma Ltd., Healthcare Pharmaceutical Ltd., Kumudini Pharmaceutical Ltd., Incepta Pharmaceutical Ltd, Ethical Drugs Ltd., PCC Corporation, Technokit Corporation, GB Medical Ltd., UniMed UniHealth Pharmaceutical Ltd. Etc and the name of food processing & manufacturing companies: Pran Foods Ltd., Aman Enterprise, ZAP Natural Product Ltd., Rawson Corporation, Ryan Trade International, Bizmate Trading International etc. GSD earned 31,47,562/- revenue through rendering irradiation to 30,750 kg food products and 3,873 cft medical and pharmaceutical products including 3,000 pcs shell dressing.

3. Other works done**Nature of secretariat work done**

- Dr. Mahfuza Khan 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.

- b. Dr. Mahfuza Khan worked as ‘Seminar Coordinator’, Institute of Food and Radiation Biology (IFRB), AERE, Savar.
- c. Dr. Mahfuza Khan worked as member of Agricultural and Food Products Divisional Committee (AFDC), BSTI, Ministry of Industry for the period of 2022-2024.
- d. Dr. Mahfuza Khan worked as Focal Point of Food safety and security.

Worked as project coordinator of different IAEA projects

- a. Dr. Mahfuza Khan worked as National Counter Part (CP) of IAEA Technical Cooperation Project BGD 5035 (2022-23cycle) ‘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’.
- b. Dr. Mahfuza Khan worked as National Counter Part (CP) of IAEA Project RAS/5095 (2022-2025) ‘Enhancing the Capacity and the Utilization of the Sterile Insect Technique for Aedes Mosquito Control’.
- c. Dr. Mahfuza Khan worked as ‘Chief Scientific Investigator (CSI)’ of Co-ordinated Research Project (CRP No. 23135/R2, 2019-2024), IAEA on ‘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’.

Work as reviewer

- a. Dr. Mahfuza Khan reviewed manuscript entitled "Appraisal of growth inhibitory, biochemical and genotoxic effects of Allyl Isothiocyanate on an agricultural pest, *Zeugodacus cucurbitae* (Coquillett) (Diptera: Tephritidae)". Scientific Reports (2022) (Springer & Nature).

3. Manpower Development

Sl. No.	Title	Date	Place	No. of participant
01.	Glimpse of Institute of Food and Radiation Biology	20.06.2023	IFRB Seminar Room	30
02.	Services Provided by Gamma Source Division (GSD), IFRB	01.06.2023	IFRB Seminar Room	25

4. Seminar/Symposium/Conference/Workshop/Meeting attended

Name of the participant	Title of the event	Organizer	Date	Place
Dr. Mahfuza Khan	11th International Symposium on Fruit Flies (11 th ISFFEI) of Economic Importance (virtual).	NSW-DPI & FAO/IAEA	13.11.2022-18.11.2022	Macquarie University, Sydney, Australia.
Dr. Mahfuza Khan	First RCM Research IAEA Coordinated Meeting (RAS/5095).	IAEA	7.11.2022-11.11.2022	Jakarta, Indonesia.
Dr. Mahfuza Khan	Third RCM, IAEA Research Coordinated Meeting (CRP No. 23135/R3).	IAEA	20.11.2022 - 24.11.2022	Macquarie University, Australia.
Dr. Mahfuza Khan	3 rd Joint Meeting of ISCE-APACE (virtual).	ISCE-APACE (International Society of Chemical Ecology-Asia-Pacific Association of Chemical Ecologist)	8.08.2022-12.08.2022	Kuala Lumpur, Malaysia.
Dr. Md. Firoz Mortuza	The Guidelines and Standards of Quality Management for Radiation Processing Facilities	IAEA	28.11.2022-02.12.2022	Kuala Lumpur, Malaysia

Name of the participant	Title of the event	Organizer	Date	Place
Arifatun Nahar	TC Regional Training Course on Surveillance, Handling and Release of Aedes Mosquitoes (TN-RAS/5095 – EVT 2301695)	Joint FAO/IAEA	12.06.2023-16.06.2023	Kuala Lumpur, Malaysia
Arifatun Nahar	Regional Workshop on Dosimetry Intercomparison, QA/QC and Quality Management Practices (ME-RAS1028-EVT-2301753)-	IAEA	19.06.2023-23.06.2023	Jeongeup, Korea
Md. Tauhidul Islam Tanim	TC Regional Training Course on Surveillance, Handling and Release of Aedes Mosquitoes (TN-RAS5095 – EVT-2301695)	Joint FAO/IAEA	12.06.2023-16.06.2023	Kuala Lumpur, Malaysia

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

a) Project Title: Improving the Quality Management Practices in Radiation Processing Facilities for Better Performance and Applications (RCA); Project Code- IAEA Regional TC:RAS/1028. Dr. Firoz Mortuza is working as Additional National Counter (ANPC) part of this project. Others divisional members are the national team members of this project.

b) 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 under CRP-D61026). Dr. Firoz Mortuza is the Chief Scientific investigator and Arifatun Nahar is Additional Chief Scientific Investigator of this project. Others divisional members are working as scientific workers in the project.

6. Service Rendered

For Research & Development (R&D) Purpose				
Sl. No.	Number of institutes/ organizations received the service	Nature of service	Total number of samples	Income (BDT)
a.	9	Food Irradiation	159 pcs	Free of cost
b.	11	Medical and Pharmaceutical Products Irradiation	3,873 pcs	
For Commercial Purpose				
a.	11	Food Irradiation	30,750 kg	10,45,500/-
b.	46	Medical and Pharmaceutical Products Irradiation	4,088 cft	21,02,052/-
			7,800 pcs Shell Dressing	38,950/-
Total = (Thirty-one lac forty seven thousand five hundred sixty two)				31,47,562/-

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. Research and Development Work(s)

1.1 Impact of Low Temperature on Survival of *Aedes aegypti* (Linnaeus) (Diptera: Culicidae) at Laboratory Condition

K. Seheli, M. F. Hossain and A. Ghosh

Sterile Insect Technique (SIT) by using γ -radiation can be considered as one of the environmentally benign approaches for mosquito control in Bangladesh. Usually, the sterile males are chilled at low temperature for convenient transportation from rear-out-facility to the release site, concurrently to minimize the metabolism, stress and physical damage. In this study, the impact of chilling temperatures (4, 7 and 10°C with control) and exposure periods (1, 4, 8 and 24h) have been investigated on the survival of lab-reared Bangladeshi *A. aegypti* strain. Different chilling temperatures had no significant effect on survival when the exposure time was 1, 4 and 8h ($P>0.05$). However, storing mosquitoes in chilled condition for 24h exhibited significant effect on survival ($P<0.01$). The optimized chilling temperature and duration were 7°C and 1h. These findings will be helpful in the implementation of SIT in Bangladesh.

1.2 Mark-Release-Recapture (MRR) of Zingerone (Zn) Aroma-Treated Male *Bactrocera zonata* (Saunders) to Methyl Eugenol (ME) Baited Trap Under Semi-Field Cage Trial

M. A. Bari and M. Khan

The *Bactrocera zonata* (Saunders), Peach fruit fly is considered as severe invasive pests of horticultural crops. Males of many *Bactrocera* species belongs to Tephritidae family are strongly attracted to methyl eugenol (ME) and Zingerone (Zn), a naturally occurring compound known as semio-chemicals. Different semio-chemicals/male lures have successfully been implemented in the male annihilation technique (MAT), or incorporated in sterile insect technique (SIT) programmes as pre-release treatments. Semio-chemicals also have a lasting effect of reduced responsiveness to male lures, and might provide a basis for development of simultaneous deployment of MAT and SIT. In this study efforts were made to determine the impact of zingerone (Zn) aroma treatment on Mark Release Recapture (MRR) of *B. zonata* to ME baited traps under the semi field cage trial. The findings recommend simultaneous deployment of Male Annihilation Technique (MAT) and Sterile Insect Technique (SIT) that would enable the immediate use of SIT to combat outbreaks of these fruit flies.

1.3 Parasitism Response of *Diachasmimorpha longicaudata* (Ashmead) to Fruits Infested by *Bactrocera dorsalis* (Hendel)

M F Hossain, M A Hossain and K Seheli

The oriental fruit fly, *Bactrocera dorsalis* (Hendel) is the most problematic species among the 34 fruit fly species documented in Bangladesh. Biological control is an increasingly employed method in the management of dacine flies because it is ecofriendly and target specific. The parasitoid *Diachasmimorpha longicaudata* (Ashmead) (Hymenoptera: Braconidae) is considered an effective biological control agent of dacine fruit flies. The parasitoid's behavior on oriental fruit fly infested (1 and 4d old) and uninfested fruits were assessed to understand the efficacy and preference of *D. longicaudata* for different host fruits. The guava was considered reference fruit to compare with banana, carambola and apple. In olfactory bioassays, the parasitoid preferred banana and guava over apple and carambola, and guava that had been infested for a longer period of time. In no-choice and dual-choice bioassays, the parasitism rate, sex ratio, and fertility were compared and in dual-choice bioassays, the parasitoid exhibited significant differences of the above parameters in guava-banana and guava-carambola but not in the guava-apple trial. In the no-choice bioassays, nothing differs substantially between guava and other fruits except the parasitism rate of guava and banana which was significantly greater in guava.

1.4 Molecular Identification of Two Major Vector Mosquitoes in Bangladesh by Using DNA Barcoding

Ghosh and K. Seheli

Accurate identification is essential for comprehending vector biology and implementing a successful control strategy. In these aspects, COI gene-based DNA barcoding is a cutting-edge species identification method that can be used to distinguish morphologically ambiguous species. It is especially helpful when starting with tiny

amounts of material from incomplete specimens or early developmental stages. In this study, the identification of *A. aegypti* and *A. albopictus* was carried out by using COI gene-based molecular techniques. Adult mosquitoes were collected from Atomic Energy Research Establishment, (AERE), Ganakbari -1349, Savar, Dhaka campus (23°57'17.443"N; 90°16'50.918"E), and complete genomic DNA was then isolated and amplified using gene-specific primers. Over 600bp mitochondrial cytochrome c oxidase I (COI) gene sequence were generated for both the species. *A. aegypti* had a nucleotide composition of A 27.9% (190), T 39.35% (268), G 16.01% (109), and C16.74% (114), while *A. albopictus* had A 28.21% (178), T 39.14% (247), G 15.69% (99), and C16.96% (107). In both sequences, the value of AT (67.25, 67.35) % is greater than GC (32.75, 32.65)%. BLAST analysis for both the species showed 97-100% homology with other submissions of the same species from Bangladesh and different geographic regions. These two species gene sequences were subsequently submitted to NCBI GenBank (Accession No. OP942188, OP060690). The identification of targeted mosquito species by this method will greatly support in effective implementation of mosquito control programs in Bangladesh including nuclear SIT technique.

2. Manpower Development

(Training program/Workshop/Seminar/Conference Arranged)

Sl. No	Title (in-house training)	Date	Place	No of participant
a)	In-house training course on office manners and general behavior –II			
b)	Any others			

3. Seminar/Symposium/Conference/Workshop/Meeting Attended

Name of the participant	Title of the event	Organizer	Date	Place
a) Dr. K. Seheli	Workshop on 'Irradiation methods and dosimetry'	IAEA	14-15 July 2022	Vienna, Austria
b) Dr. K. Seheli	2 nd RCM on 'Mosquito Irradiation, Sterilization and Quality Control'	IAEA	18-22 July 2022	Vienna, Austria
c) M. A. Bari & M. Momen	RTC on 'Mark-Release-Capture and Field Data Management' (RAS 5095)	IAEA	29 th August-02 September 2022	Vienna, Austria
d) Dr. M. A. Hossain	11 th International Symposium on Fruit flies of Economic Importance	IAEA	13-18 November 2022	Sydney, Australia
e) A. Ghosh	RTC on 'Methods for the Mass-Rearing, Irradiation and Release of sterile male <i>Aedes</i> spp'(RAS 5095)	IAEA	21 - 25 November 2022	Singapore
f) M. A. Bari	Training Course on 'E-Nothi Office Management 2023'	BAEC	08 - 12 January 2023	ICS, AERE
g)Dr. M. A. Hossain and M. A. Bari	23 rd National Conference and AGM 2022 on 'Biodiversity Conservation: Bangladesh Perspective' held on at Organized by	ZSB	28 th January 2023	DU, Dhaka
h) Dr. M. Khan , Dr. K. Seheli & A. Ghosh	1st International Dhaka Science Conference for Women-2023	IDSCW	15-16 February 2023	Pan Pacific Sonargaon, Dhaka.
i) A. Ghosh	Amar Ekushey Book fair 2023		19 February 2023	Dhaka

4. Collaboration work (ADP/FNC/MEXT/FTC/IAEA/RCA/TC/S&T/CRP/In house project, Universitiez, etc):

- 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’
- e) Collaborative research (April 2013 to date) work between IBD, IFRB and Idaho University & USDA Systematic Entomology Laboratory, Washington, USA on ‘Species diversity of tephritid fruit flies in Bangladesh’.

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.

Activities

1. Research and Development Work(s)

1.1 Comparative Microbiological Quality Analysis of Raw Milk Samples Available in Dhaka City.

Shabab Ahmed Bin Kamal, Md Kamruzzaman Pramanik and Tabassum Mumtaz.

Description: The quality control of milk is of utmost importance as it is very beneficial to our health. This study was carried out to determine the microbiological quality of fresh cow milk samples collected from local super market in Dhaka city. Two different milk Samples were examined for the determination of TVBC, TCC and *Lactobacillus* count. Pran milk sample did not yield microbial growth in any of four culture media viz Nutrient agar, PDA MRS and Mac Conkey agar. However, in local farm milk sample TVBC, TCC and *Lactobacillus* count were found to be 4.5×10^5 , 4×10^3 , and 8×10^5 cfu/ml, respectively. This result shows a contrasting scenario on the microbial quality as well as hygienic conditions during production, handling, transportation and preservation of raw milk. More in depth studies are needed to establish the standard for raw milk and milk products in Bangladesh.

1.2 Sweetened Yoghurts in Dhaka City- A Microbiological Quality Analysis Approach.

Touhidul Islam, Md Kamruzzaman Pramanik and Tabassum Mumtaz.

Description: This study was carried out to look into the microbiological quality of samples of sweetened yogurt (Dahi) obtained from local supermarkets in Dhaka city. Three different yogurt samples were examined for the determination of total viable bacterial count (TVBC), total coliform count (TCC), total yeast and mold count (TYMC), and *Lactobacillus* count. Out of three samples, only one sample (‘Pran’ sweetened yogurt) yielded microbial growth in all media. TVBC and Yeast and mold counts were 2.3×10^5 cfu/ml and 2.2×10^5 cfu/ml respectively. The *Lactobacillus* count was 3.2×10^5 cfu/ml. Microscopic observation revealed the prevalence of yeasts cells. This result shows a different scenario on the microbial quality as well as the hygienic procedures followed during the product's production and packaging. Every yogurt making plant, whether small or large, is advised to maintain overall sanitary quality and maintaining GMP is recommended to ensure high-quality, healthy yogurt.

1.3 Screening of Multi Drug Resistant Pathogens Isolated from Pharmaceutical Wastewater.

Kaniz Mehabin, Mohammad Omar Faruk and Tabassum Mumtaz..

Description: Water samples collected from antibiotic manufacturing plants were subjected to physico-chemical parameters (TDS, COD, BOD, pH, temperature) as well as bacteriological study using nutrient agar, cetrimide agar and mFC agar for isolation of presumptive organisms. All the 50 isolates undergoes antibiotic susceptibility test to determine their drug resistant pattern by Kirby-Bauer disc diffusion method on Mueller Hinton agar plates using seven different drugs from six individual groups. Several isolates showed resistance against most of the tested antibiotics. Further identification using 16sRNA and VITEK analyses are ongoing.

1.4 Screening of Lactic Acid Bacteria with Antagonistic Activity Towards Foodborne Pathogens from Chicken Intestine.

Abdullah-Al-Mahin, Banasree Bhowmik, Foysal Hossen.

Description: The excessive use of chemical preservatives in food is causing various deadly diseases in humans, so scientists are searching for biological sources of preservatives. Lactic acid bacteria (LAB) and their metabolites such as bacteriocin are being considered as potential alternatives to chemical preservatives. In this study, a comprehensive screening was undertaken to isolate LAB having antimicrobial activity from broiler chicken intestines. Antagonistic activity of the LAB isolates against different indicator strains including foodborne pathogens were investigated and three isolates were found having strong antimicrobial activity. The isolates were identified as *Lactobacillus salivarius* (2 isolates) and *Pediococcus pentosaceus* (1 isolate). Detailed characterization of identified isolates and their antimicrobial peptides is required for their use in food preservation.

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

CRP: “Development and Implementation of Cultural Heritage Preservation using Ionizing Radiation Technology (F22082).” Duration: 2023- 2028.

3. Service Rendered

Sl. No.	Name of service provided	Number/quantity of sample/patient/service	Revenue income (if any)
a	Microbiological analysis of food/ feed	17	111000/-
b	Microbiological analysis of medical and pharmaceutical products	8	19800/-
Total			130800/-

Radiation Entomology and Acarology Division, IFRB

Objective

The R & D activities of Radiation Entomology and Acarology Division focuses on (i) Application of Sterile Insect Technique (SIT) to suppress/control of blowfly (a pest of sun drying marine fish) for the production of safe, non-toxic and good quality dried fish. (ii) Development of control strategies of agricultural and stored product pests using hormone, pheromone, bio-control agents, nuclear technology and chemical pesticide. (iii) Survey collection and identification of Lepidopteran insects (moths and butterflies) to provide ecological status of those insects in the country to develop environmentally safe pest management strategies in particular, nuclear technique (F_1 sterility) and also natural conservation program and (iv) To develop insect meal use as alternative protein source for sustainable, safe and cost-effective poultry and fish feed.

Activities

1. Research and Development Work(s)

1.1 Conducting Sterile Insect Technique (SIT) Activities to Produce Safe, Non-Toxic and Healthy Dry Fish Production at Sonadia Island, Cox’s Bazar (September 2022 – April 2023)

A.T.M.F. Islam, Md. MosharrafHosain, Md. Shahinur Islamand Muhsina Yasmin

Under this program, from September 2022 to April 2023, approximately 20 lakh sterile files have been released in Sonadia for controlling blowfly (a pest of sun drying marine fish).We have arranged several awareness meeting on SIT and fish cleaning process with dry fish producers. Due to the control of harmful flies in dry fish through SIT method resulting in safe and healthy dry fish production, getting real price of dry fish, increasing the consumers' confidence, and producing the safe, healthy and non-toxic dried fish. Demand for Sonadia dried fish has increased in the country and abroad as the news of production of non-toxic dry fish in nuclear technology in Sonadia has been spread and published in print media and electronic media. It is imperative to take the following steps in the future to make the SIT technology sustainable and effective: to

preserve the dry fish produced in the SIT method for a longer period of time, to ensure the quality of safe and healthy dry fish for marketing at home and abroad, to train the dry fish producers so that they can clean the fish properly.

2. Proximate Composition of Blowfly (*Luciliacuprina*) Larvae and Pupae Meal Generated from Newly Developed Artificial Diet

A.T.M.F. Islam, Md. Mosharraf Hosain, Md. Shahinur Islam and Muhsina Yasmin

Proximate composition of blowfly, *Luciliacuprina* (Diptera: Calliphoridae) larvae and pupae meal produced from mixture of poultry viscera's and bovine blood was evaluated to determine the crude protein, crude fat, ash and amino acids content. Results revealed that larvae meal contains 37.50% crude protein, 19.39% crude fat and 22.23% ash at dry matter basis and pupae meal contains 37.73% crude protein, 19.46% crude fat and 23.15% ash at dry matter basis. The amino acids profile showed Asp 1.51%; Glu 2.14%; Ser 1.35%; His 1.76%; Gly 1.31%; Thr 2.41%; Arg 1.56%; Ala 1.61%; Tyr 0.89%; Met 1.52%; Val 0.42%; Ile 0.59%; Leu 2.08% and Lys 1.58% for larvae meal and Asp 1.63%; Glu 2.43%; Ser 1.46%; His 1.77%; Gly 1.42%; Thr 2.57%; Arg 1.67%; Ala 1.72%; Tyr 0.91%; Met 1.66%; Val 0.53%; Ile 0.71%; Leu 2.43% and Lys 1.82%. It also revealed that those nutritional value of blowfly larvae and pupae meal was almost similar or sometime higher when compared with other conventional protein sources including fish meal, soymeal and tannery waste. A recent study comparing nutritive characteristics of a range of insects has shown that the amino acid profile of dipteran insects is superior to soybean and more similar to fishmeal (Barroso et al., 2014).

3. To Assess the Bacterial Growth in Blowfly (*Lucilia cuprina*) Larval Body Heated at Two Different Hot Water Temperature

A.T.M.F. Islam, Md. Mosharraf Hosain, Md. Shahinur Islam and Muhsina Yasmin

Microbial loads in both heated (in 100°C water) and unheated larval samples were estimated which is prerequisite to produce bacteria free insect meal. Microbial loads was much higher in larvae from natural larval diet (tilapia fish) than in larvae from artificial diet because some antibacterial was mixed with artificial diet. More or less similar number of colony-forming units (CFU) in both 1 and 2 minutes hot water treatment of both (from natural and artificial diet) samples. Fiaboe, Komi; Nakimbugwe, Dorothy; Waithanji, Elizabeth (2020) reported that pathogen (*Escherichia coli*, *Salmonella typhi*, *Staphylococcus aureus* and faecal coliforms) in reared black soldier fly (BSF) and cricket, and harvested blue calliphora flies (*Calliphora vomitoria*), were effectively inactivated by boiling or roasting for five minutes. Results of present study indicated that 1 or 2 minutes hot water treatment of both was not enough to kill bacteria. So, we need further study on hot water treatment to inactivate the bacteria in harvested blowfly larvae.

4. New Records of Nymphalid Butterflies in Three Forest and One Hilly Areas in Cox's Bazar

A.T.M.F. Islam, Md. Mosharraf Hosain, Md. Shahinur Islam and Muhsina Yasmin

Field studies of butterflies were carried out in three different forests i.e. Fashiakhali forest, Medhakoschopia forest, Ramu forest and one hilly areas between Doria Nagar and Himchori Inani at Cox's Bazar. Fifteen new and very rare butterfly species of Nymphalidae family were collected and identified viz. *Junonia iphita hopferri*, *Ariadne specularia arca*, *Euthalia aconthea garuda*, *Neptis kamarupa*, *Neptis soma shania*, *Neptis (Pantoporia) paraka paraka*, *Neptis (Pantoporia) hordonia hordonia*, *Parthenosylvia apicalis*, *Polyura arja arja*, *Polyura athamas athamas*, *Polyura jalyus jalyus*, *Cupha erymanthis erymanthis*, *Tanaecia (Cynitia) lepidea cognate*, *Tanaecia (Cynitia) lepidea sthava*, *Lebadea martha martha*

2. Manpower Development

Sl. No.	Title	Place	No. of participants
1.	In- house training session	REA division	6

3. 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".

Veterinary Drug Residue Analysis Division, IFRB**Objective**

The Veterinary Drug Residue Analysis Division (VDRAD) deals with the development and application of several nuclear and allied analytical techniques for screening and confirmatory analysis of different veterinary drug residues and other contaminants in foodstuffs of animal and plant origin. The specific objective of this division is to protect public health and to promote international trade of Bangladeshi food products through providing reliable food testing services and conducting an effective residue monitoring program.

Activities**1. Research and Development Work(s)**

- I. Screening of the presence of antibiotics and mycotoxins in foodstuffs of animal and plant origin using ELISA, Radio Immunoassay (RIA), and the Microbial Inhibition Test (MIT)
- II. Qualitative and quantitative analysis of antibiotic residues and mycotoxins in foodstuffs of animal and plant origin using Chromatographic and Mass-spectrometric techniques
- III. Conducting research on deposition and depletion of antibiotics applied to food-producing animals to contribute with data to the Codex's standard setting process.
- IV. Conducting joint research with various regional and international research institutes and/or organizations for enhancing analytical skills and competence.
- V. Participating in proficiency testing (PT) programs offered by international PT providers.

2. Manpower development

Title (training program seminar/ symposium / conference /workshop)	Date	Place	No. of participant
In house training carried out on method development and validation procedures to determine antibiotic and mycotoxin residues in animal and plant originated foods (fish, meat, milk, eggs, shrimp, rice, wheat, cereals, pulses, etc.) using CHARM II, ELISA, HPLC and LC-MS/MS systems provided by Chironjit Kumar Shaha, Md. Maruf Billah Prince, Darmin Chakma, Dr. Shahabe Uddin Talukder, Md. Hedayetul Islam, Dr. Md. Nazrul Islam, Dr. M. Jahurul Islam and Dr. ASM Saifullah	Eight hours per month (July 2022-June 2023)	VDRAD, IFRB, AERE	10-15

3. Seminar/ Symposium /Conference /Workshop/Meeting Attended

Name of the participant	Title of the event	Organizer	Date	Place
Darmin Chakma	Fellowship program on "Radio receptor assay related screening and quantification method development, validation and data interpretation"	International Atomic Energy Agency (IAEA), TC Project BGD5034	31 October-16 December, 2022	Brazil
Chironjit Kumar Shaha	Fellowship program on "Radio receptor assay related screening and quantification method development, validation and data interpretation"	International Atomic Energy Agency (IAEA), TC Project BGD5034	31 October-16 December, 2022	Brazil
Dr. A S M Saifullah	Workshop on "Advancing the adoption of e-Beam/X-ray technologies in Asia and Pacific"	International Atomic Energy Agency (IAEA)	14-16 November, 2022	South Korea
Dr. Mohammad Jahurul Islam	Regional training course on "Proper Sampling, Use of Statistics, Risk Assessment and ISO/IEC 17025:2017 Including Lead Assessor Roles"	International Atomic Energy Agency (IAEA)	28 November-9 December, 2022	Pakistan

Name of the participant	Title of the event	Organizer	Date	Place
Md. Hedayetul Islam	Regional training course on “Proper Sampling, Use of Statistics, Risk Assessment and ISO/IEC 17025:2017 Including Lead Assessor Roles”	International Atomic Energy Agency (IAEA)	28 November-9 December, 2022	Pakistan
Dr. Md. Nazrul Islam	Advanced regional training on “Foodsafety and laboratory quality management”	International Atomic Energy Agency (IAEA)	08-12 May, 2023	Thailand
Md. Maruf Billah Prince	Advanced regional training on “Foodsafety and laboratory quality management”	International Atomic Energy Agency (IAEA)	08-12 May, 2023	Thailand
Dr. Md. Nazrul Islam	Fellowship program on “Isotopic LC-MS/MS Techniques (fitness for purpose) for drug residues in food”	International Atomic Energy Agency (IAEA), TC Project BGD5034	22 May-16 June, 2023	Belgium
Md. Maruf Billah Prince	Fellowship program on “Isotopic LC-MS/MS Techniques (fitness for purpose) for drug residues in food”	International Atomic Energy Agency (IAEA), TC Project BGD5034	22 May-16 June, 2023	Belgium

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

(Describe in details with title and period)

- **Non RCA Project Code: RAS5078**

Title: "Enhancing Food Safety Laboratory Capabilities and Establishing a Network in Asia to Control Veterinary Drug Residues and Related Chemical Contaminants"

Project counterpart: Dr. A S M Saifullah

- **Non RCA Project Code: RAS5096**

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.

- 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.

- 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)	Sample Analysis	182	4,19,000/-
Total		182	4,19,000/-

Plant Biotechnology and Genetic Engineering Division, IFRB

Introduction:

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 develop *Agrobacterium*- mediated genetic transformation technique to improve crop plants.
- To improve crop plants through mutation breeding using Carbon Ion beam and Gamma irradiations.
- To molecular characterization of mutant lines.

Activities

1. Research and Development Work(s)

1.1 Micropropagation of Sugarcane Through Callus (*Saccharum Officinarum L.*) Var. China Using Leaf-Sheath as Explants

M.H. Kabir*, P. Das, M. M. 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* regeneration of sugarcane via callus was described in this study using leaf-sheath as explants. A reproducible protocol for induction of callus and regeneration into plantlets were developed in sugarcane var. china. Potential callus induction was observed on MS medium supplemented with 4.5 mg/l 2,4-D, in which 80% explants induced callus inoculation after 90 days. Shoot formation from the callus was optimum on MS + 1.0 mg/l GA₃ + 0.5 mg/l Kin., in which 70% of the cultured calli formed shoots. The average number of shoots formed per culture callus was 27.0 - 2.50 and the average shoot length of 6.5 - 0.50 cm were achieved in this medium inoculation after 60 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. The average number of roots produced per shoot was 18.0 - 2.25 and the average root length of 7.50 - 1.20 cm were observed in this medium. Ninety percent of the *in vitro* raised plantlets were survived in the natural environment.

1.2 Effect of Nanoparticles on Seed Germination, Growth and Development of Rice genotype

P. Das, S.K. Sen, M.S. Manir, A. A. Mortuza, M. H. Kabir, M. A. Taher and A.N.K. Mamun

The interaction mechanism played at the molecular level between the nanoparticles and biological systems are largely unknown, which is a major concern among the scientists for the environmental applications. In this research, we have reported the impacts of shape, size, and phase of three types of TiO₂ nanoparticles (anatase, aerioxide p25 and degussa p25) on the germination and seedling growth of Nonabokra rice (*Oryza sativa L.*)

plants along with antimicrobial effectiveness and cytotoxicity test conducted on brine shrimp (*Artemia salina*). Nonabokra rice (*Oryza sativa* L.) plant was used to check the impact of TiO₂ on germination rates and seedling growth. In comparison to the large-sized (49.26 nm) spherical anatase TiO₂ nanoparticles, the smaller sized (21 nm) agglomerated (aeroxide p25 and degussa p25) TiO₂ nanoparticles exhibited better germination rates, reaching almost 97.13 % of aeroxide p25 TiO₂. According to this study, the aeroxide p25 TiO₂ has a better effect on rice seedling growth than its counterpart materials. The maximum fresh weight (FW) and dry weight (DW) of seedlings observed for aeroxide p25 TiO₂ were 166.97 and 27.50 g, respectively.

1.3 Study of B-11 Mutant Rice Lines Induced by Carbon ion Beam using SSR markers

P. Das, M.H. Kabir, M. A. Selim, M. S. Islam, M. M. Islam, and A.N.K. Mamun

Bangladesh's primary base meal is rice (*Oryza sativa* L.), one of the world's most important cereal products. One of the most essential aspects of choosing genotypes with desirable traits for an effective breeding program is understanding the nature and extent of genetic diversity. Rice's genetic diversity has diminished as a result of the intense selection pressure used in breeding since its domestication thousands of years ago. Creating variety through mutations has thus become one of the most important methods for rice improvement. Following carbon ion beam irradiation, fourteen mutant lines of B-11 rice cultivars were chosen based on better agronomic characteristics. The locus RM 30 had the fewest alleles, while the locus RM 17 had the most alleles (8.00). (4.00). The average genetic diversity value was 0.72, indicating that there is more genetic variety in 15 (mutation line) rice types. The typical gene frequency ranged between 0.125 and 0.250. PIC index values ranged from 0.479 for RM 25 to 0.815 for RM 17, respectively. Nei (1983) estimated a genetic distance that varied from 0.33 to 1.0. According to the UPGMA dendrogram study, the most closely linked mutation line varieties in the sub-clusters are B11ML-11 and B11ML-13, B11ML-02 and B11ML-09, B11ML-10 and B11ML-05.

1.4 Determination of LD50 of Local Wheat Variety(*Triticum aestivum* L.)

S.A.M. Shariar, P. Das, M.H.Kabir, M. M. Islam, M.R. Islam, M.T. Jahan, M. A. Islam and A.N.K. Mamun

Wheat (*Triticum astivum*L.) is one of the most important worldwide cultivated cereal crops. It belongs to the Poaceae family having an allohexaploid genome (2n=6x=42). It is most widely utilized crop in the world and sustained improvements in its production will be necessary to meet the needs of the rapidly increasing population in a changing environment. A considerable improvement has already been made by exploiting the natural variation through conventional breeding. For direct improvement of any agronomic trait, the basic requirement is the availability of adequate genetic variability. Induced mutations with radiation mutagen and improved treatment methods, offers possibility for the induction of desired changes in various attributes, which can be exploited as such or through recombination breeding. Mutation induction has the purpose of generate genetic and phenotypic variability, which may allow to select plants with characteristics that are not found in nature. Gamma radiation can be utilized as a mutagenic agent for inducing genetic variability in plant species. The yield of wheat productions hampered by various biotic and abiotic stresses originating from the adverse condition. Mutation induction help to increase tolerance or resistance to abiotic and biotic stresses. Therefore, the present study aimed to investigate the biological responses induced by gamma exposure and achieve an optimal dose for effective mutagenesis induction.

2. Seminar/Symposium/Conference/Workshop/Meeting Attended

Name of the participant	Title of the event	Organizer	Date	Place
Pronabananda Das, SSO	“Studies of ion beam induced mutations in plants”	MEXT Nuclear Researchers Exchange Program-2022	26 th September, 2022-3 rd February, 2023	Takasaki, Japan
Dr. Md. Humayun Kabir, PSO	Regional Training Course on Application of Double Haploidy for Mutation by Speed Breeding (MbyS), Toward Crop Improvement (RAS5088), EVT2203693.	IAEA	5 to 9 December 2022	National Research and Innovation Agency (BRIN), Jakarta, Indonesia

Name of the participant	Title of the event	Organizer	Date	Place
Dr. ANK Mamun, CSO	FNCA JFY2022 Workshop on Mutation Breeding Project	FNCA	21-23th February, 2023	Bangkok, Thailand
Scientists of PBGED	International Plant Tissue Culture and Biotechnology conference	BAPTC&B, Department of Botany	March 11-13, 2023	University of Dhaka, Bangladesh

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. IAEA/RCA Project entitled, “Developing Bioenergy crops to optimize Marginal Land Productivity through Mutation Breeding and related Techniques” **RAS5070**.
03. IAEA/RCA Project entitled, “Promoting the Application of Mutation Technique and Related Biotechnologies for the Development of Green Crop Variety” **RAS5077**.
04. IAEA/TC-Project entitled, “Strengthening capacity in the maintenance and utilization of the Tandem Accelerator Facility” **IAEA/TC-BGD0010**.
05. Forum for Nuclear Cooperation in Asia (FNCA) project entitled ‘Induced mutation for higher protein, amylase and yield in salt tolerant rice landraces by gamma irradiation’

Cytology and Biocontrol Research (CBR) Radiation, Entomology and Acarology Division (Read), IFRB Introduction

Research and Development (R&D) activities of CBR has focused on cytology, cytogenetics and biocontrol, particularly in the field of Dipteran insects.

Objectives

- To study the combination of classical genetics approaches with cytology and cytogenetic strategies to identify active genes for various phenotypes of target dipteran insect pests.
- To study the development of genomic resources for dipteran insects and emphasize how these resources can be used to understand their biology and management.
- To improve management of economically important dipteran insect pests by the early career and established researchers engaged in advancing the discipline of entomology.
- 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.

Activities

1. Research and Development Work(s)

1.1 Study on the Heterochromatin Bands in Chromosomes of *Bactrocera zonata* (Diptera: Tephritidae) in Bangladesh

Tephritid fruit flies (Diptera: Tephritidae) represent one of the major insect pest groups due to their world wide diversity and economic importance in agricultural sector. *Bactrocera zonata* is one of them and found in tropical, sub-tropical and temperate regions of the world including Bangladesh. In this study, we described a cytogenetic analysis of the heterochromatin bands in metaphase chromosomes of *B. zonata*. Karyotype exhibits variation in size and shape of the sex chromosomes. X chromosome length- 3.09µm and 3.50 µm for female and male of *B. zonata*, respectively; pericentric C-band with 18.33% heterochromatin block is observed in female X chromosome; in male, X chromosome has heterochromatin block (17.11%) in the centromere region.

A faint telomeric C⁺ band in the telomere region of the short arm is located in the X chromosome in both sexes. The telomeric band consists of 17.45% heterochromatin accumulation in female and 17.03% in male. The dot like Y chromosome is highly heterochromatic and in most cases full of c-heterochromatin. Cytogenetic information revealed from the study could improve role of heterochromatin in cytotaxonomy and evolutionary facts of the cryptic species of dipteran insects.

2. Seminar/Symposium/Conference/Workshop/Meeting Attended

Name of the participant	Title of the event	Organizer	Date	Place
Dr. Farzana Yesmin, CSO	22 nd International Biennial Conference & AGM 2021	Zoological Society of Bangladesh	18 March, 2022	Dhaka, Bangladesh
Dr. Md. Hasanuzzaman, PSO	22 nd International Biennial Conference & AGM 2021	Zoological Society of Bangladesh	18 March, 2022	Dhaka, Bangladesh

Molecular Radiobiology and Biodosimetry Division, IFRB

Objective

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.

1. Activities:

1. Research and Development Works

1.1 Optimization of Dicentric Assay Procedure for Biological Dosimetry Purpose

A. H. M. Kamal, S. Islam, A.Y.K. M. M. Rana, P. K. Roy, M. Z. Rahman

Dicentric assay protocol is a gold standard biodosimetry procedure for assessing personal radiation absorbed dose, which is an important tool for radiation emergency response and medical surveillance. Optimization of this procedure is very important as results can be varied from laboratory to laboratory depending on the source of reagent, equipment, the protocol used, and personal handling. Optimization work has been conducted in MRBD to establish the dose-response calibration curve. In this attempt, appropriate sources of reagents were selected for our laboratory to optimize the culture condition. Dye concentration and timing were optimized for the staining procedure and the image capture protocol was optimized by tuning parameters in image analysis software. Overall, the dicentric assay capability will strengthen the nuclear and radiological safety of Bangladesh.

1.2 Molecular Detection Methods of *Spodoptera Frugiperda* (Fall Armyworm) in Bangladesh

S. Islam, A. H. M. Kamal, M. Z. Rahman, P. K. Roy and A.Y.K. M. M. Rana

The fall armyworm (FAW), *Spodoptera frugiperda*, is a well-known agricultural pest of economic importance. *S. frugiperda* reduces corn yields by 17.7 million metric tons/annum. The fall armyworm consists of two morphologically undistinguishable strains, a corn strain that prefers corn, cotton, and a rice strain that prefers rice and Bermuda grass. The sequencing of the mitochondrial gene cytochrome oxidase I (COI) and the PCR of the tandem repeated fragment FR are the most frequently used markers to differentiate populations of the corn and the rice strains of *S. frugiperda*. In BLAST analysis, Bangladesh FAW specimens revealed 98-99%

nucleotide sequence identity with *S. frugiperda* voucher specimens of Indian individuals. All FAW specimens are corn strain and some specimens are hybrid host strain (Corn and Rice) specific. This study will help the researchers to control FAW invasion and destruction in Bangladesh.

2. Manpower development and Training Program

Title	Date	Place	No. of participants
In house training	July, 2021 - Jun, 2022,	MRBD, IFRB	5
MEXT the Nuclear Researchers Exchange Program FY-2022	09 November, 2022 – 03 February, 2023	Hirosaki University, Japan	1

3. Seminar/Symposium/Conferences/workshop/Meeting Attended

Name of participants	Title of the event	Organizer	Date	Place
Dr. A. Y. K. Md. Masud Rana	Monkey pox and Lassa fever infections in Animal Reservoirs and the risks for Public Health Transmission	IAEA	07 July, 2022	Online

4. Collaboration Work

- S & T Project, entitled “Molecular Evaluation of the Radioprotective Potential of Honey for the treatment of Cancer Patient Undergoing Radiotherapy”, Principal investigator: Dr. Abu Hena Mostofa Kamal, Associate investigator: Dr. A. Y. K. Md. Masud Rana(Project ID: SRG - 221003)
- R & D Project, entitled “Radio Protective and Antioxidant Effect of Lycopene from Tomato Extract (*Solanum lycopersicum*) against Radiation Induced DNA Disorders”, Project Director: Safaiatul Islam (Group ID: Biology, Medical Science and Nutrition - 133)
- 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

Objective

Burns, surgical wounds, and bone-related complications affect thousands of people in Bangladesh each year. Institute of Tissue Banking and Biomaterial Research (ITBBR) devotes its efforts to alleviating human suffering by producing clinically safe and economical tissue allografts to use in ophthalmology, orthopedic, burn & cosmetic, and oral & maxillofacial surgery. Significantly, ITBBR recently began processing and banking cranial bone autografts. ITBBR is conducting research on biomaterials like amnion, human bone materials, bovine bone, rabbit collagen, different plant extracts, and mesenchymal stem cells produced from amniotic fluid and cord blood. Furthermore, ITBBR is working to make xenograft, synthetic graft, and artificial bone substitutes used in orthopedic reconstructive surgery.

1. Activities

1. Research and Development work(s)

1.1 Procurement, Processing and Sterilization of Human Amniotic Membrane for Repair and Regeneration of Damaged Skin and Soft Tissue

F. Diba, P. C. Karmakar, T. A. Arafat, M. H. Adnan, N. Akhtar, S. M. Asaduzzaman

Human amniotic membrane (HAM) is a well-known and widely used biological dressing material in ophthalmologic surgery, plastic and aesthetic surgery, abdominal and vaginal reconstructions, and reconstructive skin surgery. It has several distinctive qualities, such as promoting epithelial cell motility, enhancing basal cell adhesion, and inducing epithelial differentiation. After normal vaginal deliveries, amniotic

sacs were retrieved from healthy, disease-free donors. The amnion was then aseptically removed from the chorion using sterile surgical tools, washed many times (six to eight times) with sterile physiological saline, spread on sterile surgical gauge, and oven dried overnight at a temperature of $40\pm 1^{\circ}\text{C}$. The dried membranes were divided into a variety of standard sizes, such as 17 cm x 10 cm, 10 cm x 10 cm, and 5 cm x 5 cm, triple packed in polythene envelopes, vacuum-sealed and appropriately labeled under the laminar flow cabinet and sterilized by gamma irradiation at a dose of 25 kGy. 1135 amniotic sacs were collected during the reporting period, and 4677 pieces of amniotic membrane allografts were made for use in clinical rehabilitation surgery.

1.2 Processing and Preservation of Allogenic Cancellous Bone Chips for the Treatment of Osteoconductive Filler of Bone Voids

M. H. Adnan, F. Diba, T. A. Arafat, P. C. Karmakar, N. Akhtar, S. M. Asaduzzaman

Allogenic cancellous bone chips are considered to be a promising graft material for the treatment of difficult skeletal defects like spinal defects, congenital deformities, degenerative bone diseases, bone fractures, gap non-union from traumatic accidents, oral and maxillofacial defects, cyst and cyst-like tumors, and so forth. Cancellous bones (femoral heads and condyles) were collected from clinically acceptable live donors receiving surgical treatment which were then temporarily stored in the hospitals under a frozen condition. Femoral heads were dissected under aseptic conditions using a surface sterilized electric band saw after the bones were brought to the tissue banking lab. Microorganisms on and/or in tissue products are inactivated or killed by radiation treatment. According to the protocol established by ITBBR based on IAEA recommendations, bone tissues were pasteurized, processed, radiation sterilized, and preserved. 24,050 cc of radiation sterilized bone allografts were prepared and 16,878 cc of bone allografts were supplied between July 2022 and June 2023 for patients undergoing orthopedic reconstruction.

1.3 Processing, Preservation and Supply of Radiation-Sterilized Cranial Bone Autograft for Use in the Repairment of Skull Defects

T. A. Arafat, P. C. Karmakar, F. Diba, M. H. Adnan, N. Akhtar, S. M. Asaduzzaman

Autologous cranial bone is one of the best substitutes in reconstructive surgery to repair the defects in the skull. The most frequent causes of defects in the skull include injuries, infections, and neurosurgical treatments. Human cranial bone processing and preservation are only done at ITBBR. The cranial bones were preserved in a frozen state (-80°C) until processing started. The frozen cranial bones were thawed to room temperature and processed in an aseptic environment. The bones were then treated with povidone iodine solution and washed with plenty of sterile distilled water. They were then double packaged in polyethylene, vacuum sealed, wrapped in fabric, and labeled with graft identification number, dose and date of gamma irradiation, preservation conditions, expiration date, etc.

The bones were then wrapped and vacuum-sealed in a third layer of polyethylene. Cranial bones were sterilized using gamma radiation and stored at -80°C and after sterility testing supplied to hospitals and clinics. 380 cranial bone autografts were supplied to hospitalized patients over this time period, and patients with traumatic head injury, brain tumors, and stroke were effectively treated utilizing these autografts.

1.4 Treatment of Oral and Maxillofacial Surgery by Radiation Sterilized Demineralized Bone Granules: Procurement, Processing, and Supply

P. C. Karmakar, F. Diba, T. A. Arafat, M. H. Adnan, N. Akhtar, S. M. Asaduzzaman

The surgical treatment of maxillofacial bone defects now includes the use of demineralized bone matrix (DBM), which is a promising technique. The DBM offers growth factors, osteoinductive proteins, and strong mechanical assistance. Additionally, there is a very little risk of disease transmission when using DBM. As a result of the mineral being removed, DBM has superior biological qualities that make it an ideal graft material for the regeneration of maxillofacial bone. The bone granule produced by ITBBR experts were demineralized with 0.6N HCl. For usage in the treatment of oral and maxillofacial bone defects, 56 vials of demineralized bone granule were created during this time.

1.5 Microbial Quality Assurance of Radiation Sterilized Tissue Allografts

T. A. Arafat, M. H. Adnan, F. Diba, P. C. Karmakar, N. Akhtar, S. M. Asaduzzaman

Effective human tissue allograft transplantation significantly enhances patients' quality of life and, in some cases, even saves lives. Allografts that are contaminated can cause serious illness or even death in the recipient. A tissue bank must offer efficient technical solutions for the procurement, storage, documentation, and transfer of graft materials in order to ensure a constant level of quality and good scientific practice.

Because the process control is precise and the procedure leaves no residue in the treated product, the use of gamma irradiation for the terminal sterilizing of tissue allografts is widely recognized. 25 kGy of gamma radiation was determined to be suitable for sterilization of tissue allografts processed in ITBBR based on the initial bioburden level and response of the contaminants. 421 amnion samples from 18 batches, 846 bone samples from 31 batches, and 576 cranial bone samples from 41 batches were analyzed during the reporting period. All samples were determined to be transplant-safe on a microbiologic level.

1.6 Synthesis of Human Amniotic Membrane-Based Hydrogel for In Vivo Burn Wound Healing

P. C. Karmakar, F. Diba, T. A. Arafat, M. H. Adnan, N. Akhtar, S. M. Asaduzzaman

Burns is a terrible phenomenon, especially in developing countries. A significant quantity of medical resources are needed for the treatment of burn patients. Therefore, it is crucial to discover a different solution for treating burn sufferers. The amniotic membrane, which is a rich source of bioactive substances, has special properties that encourage wound healing and tissue regeneration. An easily accessible and efficient treatment option for burn wounds is a hydrogel made from amniotic membrane. This research contributes in the advancement of tissue banking capabilities, enabling the availability of biomaterials readily available for burn wound healing treatment that are quick and effective. In this study, a gel made from human amniotic membrane (HAM) and *Moringa oleifera* leaves was prepared and evaluated for use in treating burns and wounds in a rat model. *Moringa oleifera* leaves were dried, powdered, and added to gel of amniotic membrane that was taken from the human placenta. Rats with burns and full-thickness wounds were then treated with the produced gel. Based on the wound healing rate, re-epithelialization, collagen deposition, inflammatory response, and histological examination, the treatment's success was assessed. Results showed that, in comparison to control groups, the formulated gel significantly accelerated wound healing and decreased inflammation. The gel formulation shown encouraging promise as a safe and efficient remedy for burns and wounds, pointing to a potential use in clinical settings. The combined Amniotic membrane and *Moringa oleifera* gel was superior with respect to biocompatibility, percentage wound contraction ($95.2 \pm 0.27\%$), histopathologic observation, and epithelialization period (24 ± 2.05) assessments to commercially available burn creams, *Moringa oleifera*, and HAM. To better understand its mode of action and optimization of its formulation for broader therapeutic application, more research is required.

1.7 Scaffold Fabrication and Determination of Their Physicochemical and Biological Properties for Use in Tissue Engineering

T. A. Arafat, M. H. Adnan, P. C. Karmakar, F. Diba, N. Akhtar, S. M. Asaduzzaman

A number of techniques are employed to create scaffolds with specific structures and properties. Researchers aim to develop scaffolds with appropriate porosity, pore size, interconnectivity, and mechanical strength to mimic the natural extracellular matrix (ECM) and provide a conducive environment for cell growth and tissue regeneration. Using synthesized HA, a series of HA/chitosan-gelatin (HA/Cs-Gel) composite scaffolds with different HA content were fabricated by thermally induced phase separation (TIPS) technique and gamma radiation. Scanning electron microscopy of the HA/Cs-Gel composite scaffold depicted a continuous structure of irregular interconnected pores. The composite scaffolds were analyzed to determine density, porosity, biodegradability, swelling kinetics, morphology, and structural properties. These scaffolds were compared with human cancellous bone allografts (HBA) prepared in the tissue engineering lab, ITBBR. The research outcomes so far have been promising and the future implications of this research could have a substantial

impact on the advancement of scaffolds for clinical trials as an alternative to bone allografts for treating bone defects. This could result in improved support for the treatment of bone defects, potentially enhancing the socio-economic development of our country.

A series of experiments were conducted to evaluate the efficacy of the scaffolds in supporting tissue growth and function both in vitro and in vivo. This research aimed at assessing the scaffolds' performance, including factors such as biocompatibility, integration with host tissues, and long-term stability. In vitro experiments involved seeding the scaffolds with relevant cell types, such as osteoblasts or mesenchymal stem cells, and analyzing their ability to adhere, proliferate, and differentiate within the scaffold structure. Parameters such as cell viability, metabolic activity, and extracellular matrix deposition were measured to determine the scaffold's capability to support tissue growth. Animal studies were then performed to evaluate the scaffolds' performance in vivo. The scaffolds were implanted into animal models with bone defects, and their interaction with host tissues was examined. Assessments included monitoring the biocompatibility of the scaffolds, analyzing the extent of tissue integration and vascularization, and evaluating the long-term stability and mechanical integrity of the implanted scaffolds. The data generated from these investigations will guide further optimization of the scaffold design and fabrication processes, leading to the development of scaffolds that offer superior tissue growth, integration, and long-term stability.

1.8 Development of Perfusion Derived Decellularized Cardiac Tissue Graft Employing Gravitational Force

P. C. Karmakar, T. A. Arafat, M. H. Adnan, F. Diba, N. Akhtar, S. M. Asaduzzaman

Perfusion decellularization has recently sparked interest in cardiac tissue engineering as a way to treat end-stage cardiac failure with a living organ equivalent. Decellularized cardiac extracellular matrices (ECMs) are a promising tissue engineering material for cardiovascular repair and regeneration. In the present study, we developed a system to successfully decellularize whole rabbit hearts through antegrade coronary perfusion only by gravity. Our method successfully removed cardiomyocytes and/or nuclei in the decellularized construct while maintaining a three-dimensional structure that resembled the native myocardium. We found that 7 hours of antegrade coronary 1% Sodium dodecyl sulphate (SDS) perfusion resulted in a completely decellularized construct. Both DNA analysis and histological analysis indicated that our system was feasible in decellularizing rabbit hearts. The clinical translation that we envision will benefit from the natural architecture of decellularized cardiovascular extracellular matrices, which has the potential for the development of solid and soluble decellularized ECM in the context of cardiovascular applications.

1.9 Determination of Microbiological Profile of Burn Wounds and The Prevalence of Drug Resistance Among the Infecting Bacteria

F. Diba, T. A. Arafat, M. H. Adnan, P. C. Karmakar, N. Akhtar, S. M. Asaduzzaman

Research on burn wound infecting bacteria and their drug resistance is crucial for understanding the microbial dynamics in burn wounds and guiding appropriate treatment strategies. Burn wounds are highly susceptible to infections, and the presence of drug-resistant bacteria poses significant challenges in managing these infections effectively.

We have investigated the microbial profile of burn wounds and the prevalence of drug resistance among the infecting bacteria. Common pathogens identified in burn wound infections include species of *Staphylococcus aureus*, *Pseudomonas aeruginosa*, *Acinetobacter* spp., and *Klebsiella* spp. Etc. Our study has elucidated the presence of multi-drug resistance in burn wound-infecting bacteria. We are investigating biofilm formation's impact on burn wound infections since biofilms provide a protective environment for bacteria, rendering them more resistant to antibiotics and immune responses. In conclusion, research on burn wound-infecting bacteria and their drug resistance offers insights into the microbial profile, resistance mechanisms, and treatment challenges in burn wound infections. This knowledge is essential for developing targeted therapies and addressing the growing threat of drug-resistant bacteria in burn care.

2. Manpower Development

SL. No.	Title (training)	Date	Place	No. of participant
a)	National Training on Human Tissue Banking	14-03-2023 to 04-04-2023	Seminar room, ITBBR	25
b)	National Training on Quality Assurance in Human Tissue Banking	02-05-2023 to 31-05-2023	Seminar room, ITBBR	15
c)	Industrial Training of Level 3, Term 2 Students of Department of Biomedical Engineering, Bangladesh University of Engineering & Technology (BUET)	14-05-2023 to 25-05-2023	ITBBR	03

3. Seminar/Symposium/Conference/Meeting Attended

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	15 th June, 2023	Sheikh Hasina National Institute of Burn and Plastic Surgery, Dhaka
Dr. Naznin Akhtar	Tissue Banking Activities: Research, Development and Application in Bangladesh	Institute of Tissue Banking and Biomaterial Research, AERE, Savar, Dhaka	19 th June, 2023	Institute of Nuclear Medicine and Allied Sciences, Faridpur.
Dr. Rayhana Awwal Dr. S.M. Asaduzzaman Dr. Naznin Akhtar Dr. Farzana Diba Md Hasib Adnan Tusher-Al-Arafat Polash Chandra Karmakar	Prevalence of Multidrug Resistant (MDR) Bacteria in Burn Patients	Institute of Tissue Banking and Biomaterial Research (ITBBR), and Sheikh Hasina National Institute of Burn and Plastic Surgery (SHNIBPS)	15 th September, 2022	Sheikh Hasina National Institute of Burn and Plastic Surgery (SHNIBPS), Dhaka.
	Total bacterial count on ICU patients for better infection management		12 th September, 2022	
	Setting up of National Skin bank		15 th June, 2023	

4. Collaboration Work/MoU

Collaborative work with Sheikh Hasina National Institute of Burn and Plastic Surgery (SHNIBPS) on determination of microbiological profile of 50 ICU burn patients and the prevalence of drug resistance among the infecting bacteria.

5. Service Rendered and Revenue Income

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)	16914	7,49,400
b	Supply of bone autografts (pcs)	380	
c	Supply of amniotic membrane allografts (pcs)	4677	71,310
	Total		8,20,710

6. Others

Public and Professional Awareness Activities

Most people in our country are unfamiliar with the idea of tissue transplantation, which is still relatively new to them. ITBBR conducts regular campaigns across the country as part of its Public Professional Awareness (PPA) program to inform the public about tissue donation, highlight how it can save lives, and explain the scientific underpinnings of transplantation. In addition to these discussions, regular meetings with doctors were scheduled to raise professional awareness.

NUCLEAR MEDICINE

NATIONAL INSTITUTE OF NUCLEAR MEDICINE AND ALLIED SCIENCES (NINMAS), SHAHBAG

Introduction

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 of the Institute

- 1) To render specialized medical services to the people using nuclear technology.
- 2) To improve and upgrade Nuclear Medicine facilities in Bangladesh.
- 3) To conduct training of physicians, physicists radio pharmacists and technologists in the field of nuclear medicine.
- 4) To conduct academic and research activities.
- 5) 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 Activities

1.1 Diagnostic

- 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.

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, five (5) residents were admitted for MD course of five (5) years duration. In 2023, nine (9) doctors have successfully obtained their post-graduate MD degree.
- One Physician from abroad has been doing his MD (Nuclear Medicine) after completion of his IAEA fellowship training in NINMAS.
- 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. Research and Development Work(s)

3.1 Research Works

- 3.1.1 Title name:** Synthesis and Quality Control of ^{11}C -Methionine at National Institute of Nuclear Medicine and Allied Sciences (NINMAS)"

Authors Name: S. C. Biswasarma, M. Anwar-Ul- Azim, M. J. Uddin, S. Islam, M. A. Kabir, M. Mamun.

- 3.1.2 Title Name:** Routine Production of [^{18}F]FDG at National Institute of Nuclear Medicine and Allied Sciences (NINMAS): Synthesis and Quality Control Protocols.

Authors Name: S. Islam, M. Anwar-Ul- Azim, M. J. Uddin, S. C. Biswasarma, M. S. Islam, M. A. Kabir, M. Mamun

- 3.1.3 Title Name:** Reaction Mechanism Study of ^{18}F labeled 2-Fluoro-2-deoxy-D-glucose, [^{18}F]FDG

Authors Name: M. S. Islam, M. Anwar-Ul- Azim, M. J. Uddin, S. Mia, H. Mehdi, Nur -e- Alam Siddque, M. Kadir, N. Hossain, S. Islam, M. A. Kabir, M. Mamun.

- 3.1.4 Title Name:** Estimating Production yield of F-18 radioisotope with 18/9 MeV Cyclotron Installed at NINMAS.

Authors Name: M. S. Mia, H. Mehdi, Nur -e- Alam Siddque, M. Kadir, M. S. Islam, S. Islam, S. C. Biswasarma, M. J. Uddin, M. Anwar-Ul- Azim, M. N. Hossain, F. Begum.

- 3.1.5 Title Name:** C-11 Radioisotope Production via the ^{13}N (p, a) ^{11}C Reaction with "Cyclone 18/9 MeV IBA Cyclotron" Installed at NINMAS.

Authors Name: M. S. Mia, H. Mehdi, S. C. Biswasarma, M. A. Islam, M. J. Uddin, T. A. Biman, M. Anwar-Ul- Azim, M. N. Hossain, F. Begum, M. N. Islam.

- 3.1.6 Title name:** Newborn screening program for the early diagnosis and treatment of Congenital Hypothyroidism: Prospect of Bangladesh.

Authors Name: M. A. Islam, S. C. Biswasarma, M. Anwar-Ul- Azim.

3.1.7 Title: Potential of DTPA Renogram in Detection of Renal Anomalies: Experience in NINMAS.

Author: S. Reza, S. Quddus, S. Sultana, U. Islam, R. Parveen, S. C. Biswasarma, S. Islam

3.1.8 Title: Last One Year Experience of Hida Scan At NINMAS 2022 -2023.

Author: U. Islam, N. Sultana, S. Reza, R. Parveen.

3.1.9 Title: Similarity and Dissimilarity between Myocardial Perfusion Imaging and Dobutamin Stress Echo.

Author: S. Reza, S. Quddus, N. Sultana, U. Islam, R. Parveen, T. Mandal, S. Alam, F. R. Ananna, S. C. Biswasarma

IN-HOUSE Researches

3.1.10 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.

3.1.11 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.

3.1.12 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.

3.1.13 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.

3.1.14 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.

3.1.15 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.

3.1.16 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.

3.2 Development Works

1. Development and Upgrading of Hot-lab facilities of NINMAS; Prof. Ferdoushi Begum, Md. Nahid Hossain and coworkers.
2. Optimization of F-18 radioisotope production with “Cyclone 18/9 MeV IBA Cyclotron ” Installed at NINMAS. Md. Nahid Hossain and coworkers
3. Development of the shielding structure at different lab of the institute to ensure the minimum radiation dose in the room. Prof. Ferdoushi Begum, Md. Nahid Hossain and coworkers.

3.3 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. Prepared instrument’s present and past status, Prof. Ferdoushi Begum, Md. Nahid Hossain and Coworkers.

3.4 Chapter of Book

- Dr. N. Sultana, “Infection Imaging in Nuclear Medicine from Asian Nuclear Medicine Board. (ANMB). <https://drive.google.com/file/d/1RESiZUc14eMDq1Z4j258T-OqUzumD-oJ/view?usp=sharing>.

3.5 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, ^{18}F , ^{15}O , ^{13}N , ^{11}C and other isotopes from solid targets for Positron Emission Tomography (PET) imaging. Presently the cyclotron has been exclusively used for the production of ^{18}F for ^{18}F -FDG PET imaging. ^{18}F -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 ^{18}F -NaF, ^{18}F -FLT and ^{18}F -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 2022- June 2023	NINMAS, Dhaka	82 (group wise)
2.	Weekly Scientific Seminar	July 2022-June 2023	NINMAS, Dhaka	Per week 45
3.	In-house Training Course on HPGe Detector	7-9 Nov, 2022	Centre for Cyclotron facilities and Molecular Imaging, BSMMU	10
4.	Training on IBA Cyclotron Operation, maintenance and troubleshooting, HVAC and Chiller operation and maintenance, Electrical system	08-25 January 2023	Centre for Cyclotron facilities and Molecular Imaging, NINMAS	12
5.	In-house Training Course on Radio-HPLC	1-2 Feb, 2023	Centre for Cyclotron facilities and Molecular Imaging, BSMMU	5

5. Manpower Development (Training Attended)

Sl No.	Name of the participant	Title of the event	Organizer	Date	Place
1.	Md Nahid Hossain, Sanchoy Chandra Biswasarma	Janus (Liquid Handling System) Customer training	Hopkinton USA	12-16 June 2023	Hopkinton USA

6. Seminar/Symposium/Conference/Workshop/Meeting attended

Name of the participant	Title of the Event	Organizer	Date	Place
Dr. P. Akhter	Workshop on Carotid Doppler Ultrasound	BSU	29 July 2022	Dhaka
M. N. Hossain	Participated in the Second International Conference on Applications of Radiation Science and Technology (ICARST-2022)	IAEA	22-26 August 2022	VIC, Vienna, Austria.
Dr. T. Mandal	IEA RCA Regional Training Course on Pediatric Nuclear Medicine and Theranostics	IAEA, RCA	5-9 September 2022	Japan (Virtual)

Name of the participant	Title of the Event	Organizer	Date	Place
Dr. S. M. F. Begum, Dr. S. Sultana, Dr. F. Begum, F. Begum, Dr. A. K. M. Fazlul 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, H. Mehdi, M. Nur-E Alam Siddiquee, M. S. Islam, S. Islam	A Scientific luncheon Seminar	Renata Limited	08 September 2022	NINMAS
Dr. S. M. F. Begum	PET-CT Scan, The State-of-the-Art Nuclear Medicine & Molecular Imaging Procedures	Oncology Expert Forum	16 September 2022	La-Vita Hall, Lakeshore Hotel Dhaka
Dr. P. Mutsuddy	Seminar on World Osteoporosis	BSMMU	20 October, 2022	Dr. Shahid Milton Hall
Dr. M. A. B. Siddique, Dr. P. Akhter	4 th National Conference of Bangladesh Society of Ultrasonography	BSU	28 October 2022	Intercontinental Hotel
Dr. P. Akhter, Dr. U. Islam	21 st Annual General Meeting of ARCCNM and 61 st KNSM	Asian Nuclear Medicine Board	2-5 November 2022	South Korea
Dr. S. M. F. Begum, Dr. P. Mutsuddy, Dr. T. Mandal, S. Parveen	Scientific Seminar & Inauguration Program of Parathyroid Scanning & Lymphoscintigraphy	INMAS, Dinajpur	5 November, 2022	INMAS, Dinajpur
Dr. S. Sultana, Dr. F. Begum, Dr. M. A. B. Siddique, M. Anwar-ul-Azim, 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, H. Mehdi, S. C. Biswasarma, M. S. Islam, M. Kadir	Working Safely with Fume Hood, Biosafety cabinet, and Isolators in Radio pharmacy Application	Esco Lifesciences Group	01 February 2023	NINMAS, Dhaka
Dr. M. Anwar-ul-Azim, S. C. Biswasarma	International Conference of BSBMB-SABC-OMC 2023	University of Dhaka	03-05 February 2023	NNACSB University of Dhaka
Dr. P. Mutsuddy, Dr. T. Mandal, Dr. P. Akhter, Dr. U. Islam	Nuclear Medicine Update 2023	Singapore Nuclear Medicine Society	8-12 February 2023	Singapore
M. N. Hossain	Participated in the International Conference on Effective Nuclear and Radiation Regulatory Systems: Preparing for the Future in a Rapidly Changing Environment	IAEA	13-16 February 2023	Abu Dhabi, United Arab Emirates.
Dr. S. Sultana, Dr. F. Begum, F. Begum, Dr. A. K. M. F. Bari, Dr. N. Sultana, Dr. M. A. B. Siddique, M. N. Hossain, Dr. M. Anwar-ul-Azim, Dr. P. Mutsuddy, Dr. R. Parveen, Dr.	26 th National Conference of Society of Nuclear Medicine	SNMB	10-11 March, 2023	BRAC Learning Centre, Dinajpur

Name of the participant	Title of the Event	Organizer	Date	Place
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				
Dr. S. Sultana, Dr. F. Begum, F. Begum, Dr. A. K. M. F. Bari, Dr. N. Sultana, Dr. M. A. B. Siddique, Dr. M. Anwar-ul-Azim, 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	Biotin Interfere in Immunoassay” & “Abbott Total Lab Automation System and AlinIQ-AMS Digital Health Solution	SNMB	02 May 2023	NINMAS, Dhaka
Dr. S. M. F. Begum, 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, S. Mia, H. Mehdi, M. Nur-E Alam Siddiquee, M. S. Islam, M. Kadir, S. Islam	Webinar: World Thyroid day 2022	NINMAS	25 May, 2023	NINMAS 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, Genetics of Thyroid Disorders	BTS	30 May 2023	NINMAS, Dhaka
S. Mia, H. Mehdi, M. Nur-E Alam Siddiquee, M. S. Islam, M. Kadir, S. Islam	Biotin Interference on Immunoassay	Abbott	15 June, 2023	Radisson Blue Water Garden Hotel, Dhaka

7. 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

8. Service Rendered and Revenue Income

Name of service	No. of sample/patient	Income
Number of Patients	77,279	11,11,49,053.20/-
Blood Samples Analysis	1,72,701	
[¹⁸ F]FDG Production	71.512 mCi	

INSTITUTE OF NUCLEAR MEDICINE AND ALLIED SCIENCES (INMAS), DHAKA

Objective

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 patients health care services are offered from this institute as regular basis. Our objectives to render specilized medical services by using nuclear technology and also conduct academic & research activities.

1. Manpower Development

Sl. No.	Title (training program/ workshop/seminar/ symposium/conference)	Date	Place	No. of participant
a)	Weekly Seminar	Every Sunday	INMAS, Dhaka	11

2. Seminar/ Symposium/Conference/ Workshop/Meeting Attended

Name of the participant	Title of the event	Organizer	Date	Place
Dr. Rawnak Afrin Dr. Afroza Akhter Dr. Shaila Sharmin Dr. Sabrina Islam	13 th congress WFNMB 2022	WFNMB	9-11 September 2022	Kyoto Japan
Dr. Jasmine Ara Haque Dr. Rubina Begum Dr. Farhana Rahman Dr. Rawnak Afrin Dr. Mohana Hossain Dr. Sadia Hossain Dr. Tania Sultana Dr. Tanima Biswas Dr. Afroza Akhter Dr. Shaila Sharmin Dr. Sabrina Islam	35 th National conference	Society of Ultrasonography	October, 2022	Bangladesh

Name of the participant	Title of the event	Organizer	Date	Place
Dr. Afroza Akhter Dr. Shaila Sharmin	ANMB Exam 2022 & Annual Meeting of ARCCNM & KSNM	ANMB, ARCCNM, KSNM	2-5 November 2022	South Korea
Prof. Dr. Shankar Biswas Dr. Afroza Akhter	IMIC 2022	IAEA	13-16 December 2022	Austria Vienna
Prof. Jasmine Ara Haque	AFSUMB 2022	AFSUMB	11-13 November 2022	India
Dr. Jasmine Ara Haque Dr. Rubina Begum Dr. Farhana Rahman Dr. Rawnak Afrin Dr. Mohana Hossain Dr. Sadia Hossain Dr. Tania Sultana Dr. Tanim Biswas Dr. Afroza Akhter Dr. Shaila Sharmin Dr. Sabrina Islam	Training on Basic Ultrasonography	OGSB	14 th January, 2023	Bangladesh
Dr. Jasmine Ara Haque	Nuclear Medicine Update	NMSS	9-11 February	Singapore
Dr. Shankar Biswas	Bangladesh Live 2023	IPDI Bangladesh	2-5 May 2023	Bangladesh
Dr. Afroza Akhter	BIT Summit 2023	Bangla Interventional Therapeutics (BIT)	3-5 February 2023	Bangladesh
Dr. Rawnak Afrin	International scientific Seminar and 30 th National Convention of BSRI	BSRI	2023	Bangladesh

3. Collaboration Work/MoU

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	41094	6,34,01,940

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.

Activities**1. Clinical Activities****1.1 Diagnostic Service**

- Scintigraphic scan includes Bone scan, Renal scan (DTPA, DMSA), HIDA scan, Hepatobiliary scan, Thyroid scan and Parathyroid scan, Lymphoscintigraphy,
- All sort of diagnostic USG including normal B-Scan of different organ, HRUS of superficial organs .
- Duplex study of vascular system
- In Vitro diagnostic services includes hormone analysis like T_3 , T_4 , FT_3 , FT_4 , TSH, FSH, LH Prolactine, Testosterone, Eestrogen, Progesterone. Different types of thyroid antibody and tumor marker i.e. Tg are routinely performed in this institute.

1.2 Therapeutic service

Therapeutic activities include radioiodine therapy of thyroid cancer and hyperthyroid patients.

2. Research and Development Work(s)**In-house Research**

- Interrelationship between skeletal and visceral metastases in invasive carcinoma of breast.
- Complementary Role of Thyroid Scintigraphy, Neck USG and biochemical assay to delineate thyroid disease pattern.
- Application of a categorical classification for assessment of kidney undergoing intervention with obstructive features.
- Pre operative grading of Intra cranial glioma using MRI
- Use of high frequency Ultrasound in detection and localization of soft tissue foreign body.

3. Project

Project “ Enhance capacity of Institute of Nuclear Medicine and allied Sciences (INMAS) at Mitford, Cumilla, Faridpur, Barishal and Bogura” is going on.

4. Manpower Development

Sl. No	Title of event	Date	Place	No of participant
a)	“তথ্য অধিকার”অভিযোগ প্রতিকার ব্যবস্থা ও জিআরএস সফটওয়্যার“ এবং “সেবা প্রদান প্রতিশ্রুতি“ বিষয়ক প্রশিক্ষণ	8/12/2022	BAEC Dhaka	1
b)	চাকুরীর আচরণ বিধি ও নিয়ম-স্থলা সংক্রান্ত প্রশিক্ষণ	21/12/2022	INMAS, Mitford	6
c)	“তথ্য অধিকার”অভিযোগ প্রতিকার ব্যবস্থা ও জিআরএস সফটওয়্যার“ এবং “সেবা প্রদান প্রতিশ্রুতি“ বিষয়ক প্রশিক্ষণ	29/09/2022	BAEC Dhaka	1
d)	Workshop on Delta Plan 2100 ডেল্টাপ্ল্যান-২১০০ বিষয়ক কর্মশালা	22/01/2023	Dhaka	1
e)	Integrated Digital Service Delivery platform (IDSDP)	15/6/2023	BAEC Dhaka	2

	Part-2 UAT phase & training			
f)	অগ্নি নিরাপত্তা সচেতনতার লক্ষ্যে হাতে-কলমে প্রশিক্ষণ	09/03/2023	INMAS Mitford	5
g)	Integrated Digital Service Delivery platform (IDSDP) Part-2 UAT phase & training	22/06/2023	BAEC Dhaka	1
h)	“ iBAS++ Autonomous Body” kxl©K mve-gwWD†ji Personal Account (PL) m,,R†bi wel†q Workshop	25/06/2023	BAEC Dhaka	1

5. Seminar/Symposium/Conference/Workshop/Meeting Attended

Name of the participant	Title of the event	Organizer	Date	Place
Dr. Hosne Ara Rahman Dr. Samira Sharmin Dr. Afroza Naznin Dr. Farida Yasmin	34 th National conference	BSU	28th October 2022	Dhaka
Dr. Hosne Ara Rahman Dr. Samira Sharmin Dr. Afroza Naznin	26 th National Conference of SNMB	SNMB	10-11 ^h March 2023	Dinajpur
Dr. Afroza Naznin	Workshop on BMD Machine ‘STRATOS/ STRATOS DR	-		France
Dr. Afroza Naznin	21 st Annual Meeting of ARCCNM & 61 st Annual Meeting of KSNM	ARCCNM	2-6 th November 2022	S. Korea
Dr. Samira Sharmin Dr. Afroza Naznin Dr. Farida Yasmin	2 nd International Ultrasound workshop on live intervention & hand on training on Phantom and many more on Ultrasound	Shristy Ins. For Health Science & Technology	25-26 November 2022	Dhaka
Dr. Hosne Ara Rahman Dr. Samira Sharmin Dr. Afroza Naznin	Thyroid Symposium	Bangladesh Thyroid Society	22nd November 2022	Dhaka
Dr. Hosne Ara Rahman Dr. Samira Sharmin Dr. Afroza Naznin Dr. Farida Yasmin	CME of SSMCH	SSMCH	27th November2 022	Dhaka
Dr. Samira Sharmin Dr. Afroza Naznin Dr. Farida Yasmin Dr. Arshad Hossain	Carotid Doppler Workshop	BSU	29 th July 2022	Dhaka
Mr. Arun Kumar Paul	4th IR related tools and technology adaptation to conquer its Challenges	BAEC	23 rd January 2023	Dhaka
Dr. Samira Sharmin Dr. Afroza Naznin Dr. Farida Yasmin Dr. Jerin Sultana Dr. Arshad Hossain	27th WFUMB COE workshop	WFUMB	3-4th March 2023	Dhaka

Name of the participant	Title of the event	Organizer	Date	Place
Dr. Farida Yasmin	National Conference on Physics 2023	Bangladesh Physical Society	9-11 March 2023	Savar
Dr. Farida Yasmin	2 nd International Conference on Interventional Radiology & Hands-on workshop	Society of Vascular & Interventional Radiology	13-14 th May 2023	Dhaka

6. Stakeholder Meeting

জাতীয় শুদ্ধাচার কৌশল কর্ম পরিকল্পনা ২০২-২৩ এর সূচক মোতাবেক গণশুনানী আয়োজন ও সেবা গ্রহীতাদের অভিযোগ বিষয়ে মত বিনিময় সভা

(one meeting in each quarter) ইনমাস, মিটফোর্ড।

7. Others

- 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

8. Service Rendered

Name of service provided	Number of patient	Income (If any)
a) Scintigraphy service	631	1,85,97,250/-
b) Blood sample analysis	10419	
c) I 131 Therapy	62	
d) USG and others	17229	

INSTITUTE OF NUCLEAR MEDICINE AND ALLIED SCIENCES (INMAS), CHATTOGRAM

Objective

Institute of Nuclear Medicine & Allied Sciences, Chattogram is one of the oldest Nuclear Medicine Institute in Bangladesh and was established in 1970. With the vision to render specialized medical services to the people using nuclear technology for peaceful uses of atomic energy to achieve self-reliance for overall socio-economic development. This institute is presently functioning with facilities like Dual Head & Single Head SPECT Gamma Camera, SPECT-CT, CT Scanner, Thyroid Scanner, Ultrasonogram, Colour Doppler and In-Vitro & Hormone Laboratory for Radioimmunoassay (RIA) with Computerized Gamma Well Counter and other necessary facilities.

Activities

1. Regular Services

This institute is regularly providing the following services:

- Radionuclide imaging: Bone Scan, Renogram, Renal Scan, Thyroid Scan, RAI¹³¹ Uptake, Post Therapy Scan, LDS, Liver Scan, RBC Scan, Testicular scan, Parathyroid scan & HIDA scan etc.
- Radionuclide Therapy:
 - Radio Iodine therapy for thyrotoxicosis and Ca-thyroid patients.
 - Radiation therapy after pterygium operation of eye.
- Radioimmunoassay: T3, T4, TSH, FT3, FT4, & TG and also several other hormones like LH, FSH, Prolactin, Testosterone, Progesterone, Estradiol, AFP and Cortisol etc.

- Ultrasound:

1. General Ultrasound (Whole Abdomen, Lower/Upper Abdomen, Pregnancy profile, HBS, KUB etc.)
2. High Resolution Ultrasound (Thyroid, Scrotum, Breast, Endocavitary Studies etc.)

- Colour Doppler: Lower Limbs, Upper Limbs, Carotid Arteries, Testis, Pregnancy etc.

- Thyroid Clinic: Thyroid cancer, hyperthyroidism, hypothyroidism patients came for treatment and follow up.

2. Budget allocation, Release & Source of fund & Centre/Institute wise budget allocation

Description	Taka
Salary	130.00 Lac
Allowance	120.00 Lac
Supply & Service	80.00 Lac
R & D	2.00 Lac
Others	7.00 Lac
ICT	1.00 Lac
Other's Capital	1.00 Lac
Instruments	2.00 Lac
Total Amount =	343.00 Lac

3. Manpower Development

Sl. No.	Title (training program/workshop/seminar/symposium/ conference)	Date	Place	No. of participant
a)	Procurement Management Course	17-28 July, 2022	RPATC, Chattogram	1
b)	Fundamental Training Course	24-04 Augst,2022	RPATC, Chattogram	2
c)	Workshop on Women and Child Rights	25 Augst,2022	RPATC, Chattogram	1
d)	Office Management and ICT Course	28-8 September,2022	RPATC, Chattogram	2
e)	Workshop on National Integrity Strategy (NIS)	28 September, 2022	RPATC, Chattogram	1
f)	Training Course on “Environmental Radioactivity Monitoring (ERM)”	15-19 January 2023	Training Institute AERE, Savar,Dhaka	1
g)	Clinical Training On “Dual Head SPECT Gamma Camera With accessories”	15-18 May,2023	INMAS, Mohakhali, Dhaka	1
h)	Training on “ How to use Fire Extinguishers”	27 May,2023	INMAS, Chattogram	1
i)	Course on “Ultrasound in obstetrics and Gynecology”	27-28 January 2023	Radisson Blu Dhaka	1

4. Seminar/Symposium/Conference/Workshop/Meeting Attended:

	Name of the Participant	Title of the event	Organizer	Date	Place
a)	Dr. Pabitra Kumar Bhattacharjee, Dr. Mohammad Sazzad Hossain	34 th National Conference of the Bangladesh Society of	Bangladesh Society of Ultrasonography	28 October,	Hotel Intercontinental,Dhaka.

	Name of the Participant	Title of the event	Organizer	Date	Place
	and Dr. Noor-E-Amrin Alim	Ultrasonography		2022	
b)	Dr. Mohammad Sazzad Hossain	27 th WFUMB COE Workshop	Bangladesh Society of Ultrasonography	3-4 March, 2023	BIAM Foundation, Eskaton, Dhaka.
c)	Dr. Pabitra Kumar Bhattacharjee and Dr. Muhammad Farhan Muhtasim	26 th National Conference Society of Nuclear Medicine, Bangladesh	Society of Nuclear Medicine, Bangladesh	10-11 March, 2023	BRAC Learning Center, Dinajpur

5. Others

Twenty four students of Chattogram Poly Technique Institute participated in a three months Nuclear Medicine Instrumentations training in our Institute and successfully completed that training.

6. Service Rendered

Sl. No.	Name of service provided	Number/quantity of sample/patient/service	Revenue income (if any)
a	Patient Service	28,456	4,42,59,800/-
b	Sample Analysis (including blood sample)	30,375	
c	Irradiation of Food/Medical Products		
Total		58,831	4,42,59,800/-

INSTITUTE OF NUCLEAR MEDICINE AND ALLIED SCIENCES (INMAS), MYMENSINGH

Introduction

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 medicine. INMAS, Mymensingh has been started its work in 1989 using Nuclear technology in the Department of Radiology of MMCH occupying 3 rooms only naming as Nuclear Medicine Centre. At present it stands in its own 3 storied building in the north-east corner of MMCH. All the major Nuclear Medicine investigations and Ultrasound imaging are done in this Institute. This Institute offer Nuclear Medicine therapy services in hyperthyroidism and thyroid cancer. All the investigations and therapy offered by the Institute in a subsidized cost as determined by the commission and adjusted time to time. This Institute is also a hub of radioimmunoassay performing about 26 types of hormone & cancer marker studies. A host of senior & junior qualified & skilled Doctors and technologists are working in this Institute. They are all dedicated to offer best therapeutic & investigation skill to the service of humanity. 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 and staging of cancer patients.

Objective

- 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.

Activities**1. Regular Activities**

- Medical services by diagnosis of diseases and treatment of a number of diseases.
- Research, Development & Academic activities.
- Developing facility to start postgraduate MD residency course in Nuclear Medicine under BSMMU.
- To provide attachment training to the postgraduate medical students in their MD, MS residency program.

2. Academic Activities

- Series of lectures were arranged on SPECT-CT for doctors, scientist & scientific staff of INMAS, Mymensingh.
- Series of lectures on radiation control and safety were held on during this period for scientific staffs of INMAS, Mymensingh.
- Scheduled lectures were delivered routine to Postgraduate students of different disciplines (MD, MS, DEM) of MMCH and students placed For Practical demonstration.
- Weekly journal meeting as continuous education program conducted on recent Nuclear Medicine and Allied science related works regularly in this institute.
- Participation in weekly clinical meeting and journal club arranged by MMCH & MMC where highlighted Nuclear Medicine and Allied Science related facilities.

3. Manpower Development

Sl. No.	Title	Date	Place	No. of participant
i.	Training Course on Public Procurement rules (PPR)-2008 and Public Procurement Management	10.10.2022 to 20.10.2022	Training Institute AERE, Savar, Dhaka.	01
ii.	Environmental Radioactivity Monitoring Course at BAEC (ERMC-10)	15.03.2023	Training Institute AERE, Savar, Dhaka.	01
iii.	Workshop on Annual Performance Agreement (APA) Course.	11.04.2023	RPATC, New Eskaton, Dhaka.	01
iv.	Seminar on Nuclear Medicine in Thyroid Diseases	12.06.2023	Shaheed Raisul Hasan Noman Auditorium. MMC, Mymensingh.	01
v.	Workshop on Digital Leadership	12.06.2023	RPATC, New Eskaton, Dhaka.	01

4. Seminar/Symposium/Conference/Workshop/Meeting Attended

Name of the participant	Title of the event	Organizer	Date	Place
Prof. Dr. Mohammad Nasim Khan, Prof. Dr. Ratan Kumar Chacrabarty, Dr. Shakila Zaman Rima, Dr. Rowshan Ara.	34 th National Conference of Bangladesh Society of Ultrasonography	BSU	28.10.2022	Ball Room Pan Pacific Sonargaon
Prof. Dr. M. Nasim Khan, Prof. Dr. Ratan Kumar Chacrabarty, Dr. Shakila Zaman Rima, Dr. Md Nadiruzzaman, Dr. Nazmun Nahar Shapla, Dr. Rowshan Ara Ruma, Dr. Fahima Akhter Dowel, Dr. Nayema Rahman Anu.	Scientific Seminar on Update on Gestational Trophoblastic Disease: Role of Ultrasound.	INMAS, Mymensingh	01/12/2022	Gallery 2, MMC, Mymensingh
Prof. Dr M. Nasim Khan, Prof. Dr Ratan Kumar Chacrabarty, Dr Shakila Zaman	Symposium on Update on Conventional Ultrasound	INMAS, Mymensingh	28.12.2022	Conference Room

Name of the participant	Title of the event	Organizer	Date	Place
Rima, Dr. Md Nadiruzzaman, Dr. Nazmun Nahar Shapla, Dr. Rowshan Ara Ruma, Dr. Fahima Akhter Dowel, Dr. Nayema Rahman Anu. Md. Mojibur Rahman. Umme Khaleda, Mohammad Asaduzzaman. Afroja Binte Wahid.	for lymph node Evaluation			INMAS, Mymensingh
Prof. Dr Ratan Kumar Chacrabarty, Abdul Karim, Md. Asaduzzaman, Harun-or-Rashid, Ashik Ullah, Jubair Ahmed, Ishaque Ali, Nazim Uddin.	26 th National Conference of Society of Nuclear Medicine, Bangladesh.	SNMB	10.03.2023 to 11.03.2023	BRAC Learning Center, Dinajpur

5. Stakeholder Meeting

Name of the title	Place	Date	Participants
Briefing Meeting on Service providing Commitments among the Stakeholders.	Conference Room INMAS, Mymensingh	17.06.2023	21

6. Collaboration work/MoU

IAEA RCA Project “ Strengthening Hybrid Imaging in Nuclear Medicine in Asia (RAS 6079)”

7. Service Rendered

Sl. No.	Name of service provided	Number of sample/patient	Revenue income
i.	Patient Service (including imaging & Therapy)	30202	1,75,41,250/-
ii.	Sample Analysis (including blood sample)	61271	4,54,83,370/-
Total =		91473	6,30,24,620/-

8. Others

- The Institute provides research facility for post graduate students of MD, MS, M Phil & PhD program of different institutes such as MMC.
- Radioimmunoassay laboratory provide services to different research programs of different discipline of medical sciences.
- This Institute provides facility to perform research program in association with other institutes such as MMC & BAU, Mymensingh.
- All the necessary informations are provided in Institute’s own website www.inmasmym.org .

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.

Activities

1. Clinical services

1.1 Diagnostic

- 2D/3D Ultrasonogram (USG) , Transvaginal sonogram (TVS) , High resolution USG of superficial organs and color Doppler study of vascular system.

- All thyroid related hormones, gonadal hormones of both male and female different tumor markers. Serum vitamin- D level estimation.
- Different radionuclide scanning and thyroid uptake study.
- Bone Mineral Densitometry (BMD) & Computed Tomography (CT Scan)

1.2 Therapeutic

- RAI therapy for differentiated thyroid cancer and hyperthyroid patients.
- Toxic & Ca-thyroid Patients are followed up periodically for the rest of their lives.
- Hypothyroid patients are routinely followed up.

2. Manpower Development

Sl. No.	Title (Training program/Workshop/Seminar/ Symposium/ Conference)	Date	Place	No. of Participant
a)	Operational and Clinical Training on Dual Head SPECT-CT	17-06-22	Germany.	1
b)	Commitment to Provide Service	18-07-22	INMAS, Sylhet	21
c)	Integrity Training	20-08-22	INMAS, Sylhet	21
d)	Commitment to Provide Service	08-09-22	INMAS, Sylhet	22
e)	Integrity Training	20-10-22	INMAS, Sylhet	21
f)	Commitment to Provide Service	16-11-22	INMAS, Sylhet	25
g)	Grievance Redressal Management	21-12-22	INMAS, Sylhet	24
h)	Integrity Training	17-01-23	INMAS, Sylhet	21
i)	Symbia Intevo Bold SPECT- CT System Post-Installation Hand-Over Training	29 jan-02 Feb/23	Inmas Sylhet	05
j)	Integrity Training	15-03-23	INMAS, Sylhet	21
k)	Integrity Training	12-04-23	INMAS, Sylhet	21
l)	Commitment to Provide Service	30-05-23	INMAS, Sylhet	20

3. Seminar/Symposium/Conference/Workshop/Meeting Attended

Name of the Participant	Title of the event	Organizer	Date	Place
Dr. Kamrun Nahar, Director Dr. Mohammad Mehedi Al Zahid Bhuiyan, M.O.	25 th National Conference of Bangladesh thyroid society.	Bangladesh Thyroid Society	17-06-2022	Hotel Sonargoen Dhaka
Dr. Kamrun Nahar, Director Dr. Mohammad Mehedi Al Zahid Bhuiyan, M.O. Dr. Md Azad Mia, M.O.	34 th National Conference of the Bangladesh Society of Ultrasonography	Society of Ultrasonography	28-10-2022	Hotel International Dhaka
Dr. Kamrun Nahar, Director Mohammad Razaul Karim S.S.A	26 th National Conference of the Society Of Nuclear Medicine, Bangladesh	SNMB	10-11 March 2023	Dinajpur

4. Stakeholder Meeting

Title of the event	Date	Place	No. of participant
Grievance Redressal management with participation of stakeholders in coordination meeting	21-12-2022	Inmas Sylhet	33

5. Academic Activities

Title of the event	Date	Place	No. of participant
Residence of MS phase A Pediatric Surgery	01-10-22 to 10-10-22	Inmas, Sylhet	01
Residence of MS phase A Pediatric Surgery	16-12-22 to 31-12-22	Inmas, Sylhet	01
Residence of MS (Otolaryngology)	01-01-23 to 14-01-23	Inmas, Sylhet	02
Residence of MD (Radiology & Imaging) Phase A	16-03-23 to 30-03-23	Inmas, Sylhet	04
Residence of MS (Orthopedics)	16-05-23 to 31-05-23	Inmas, Sylhet	02

6. Service Rendered

Sl. No.	Name of service provided	Number/quantity of sample/patient/service	Revenue income (if any)
a	Patient Service	30,993	1,90,57,550/-
b	Sample Analysis(including blood sample)	18669	

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.

Activities**1. Repair, Maintenance and Renovation work(s)**

Renovation works of old building has done.

2. Manpower Development

SL. No	Title(training program/workshop/seminar/symposium/conference)	Date	Place	No. of participant
a	In-Plant Training of 4 th year students of Bio-Chemistry and Molecular biology, University of Rajshahi	10-22 Dec 2022	INMAS, Rajshahi	05
b	MD (Internal Medicine/Oncology) Residency course training	24 Sep - 29 Sep 22 01 Jan - 09 Jan 23 16 Jan - 22 Jan 23 01 Feb - 14 Feb 23	INMAS, Rajshahi	09
c	Training on Medical Technology (B. Sc), Institute of Health Technology Rajshahi & Rajshahi Institute of Medical Technology.	29 Mar - 11 Apr 23	INMAS, Rajshahi	05
d	Training on Medical Technology (Diploma), IHT, Rajshahi.	29 Mar - 03 Apr 23 29 Apr - 03 May 23 28 May - 01 Jun 23	INMAS, Rajshahi	29

3. Seminar/Symposium/Conference/Workshop/Meeting attendant

Name of the participant	Title of the event	Organizer	Date	Place
All Doctors INMAS, Rajshahi	34 th National Conference of Bangladesh Society of Ultrasonography	BSU	28 Oct 22	Dhaka
All Doctors INMAS, Rajshahi	26 th National Conference of SNMB	SNMB	10 Mar 23	Dinajpur

4. Stakeholder Meeting

Name of the participant	Title of the event	Organizer	Date	Place
Officers INMAS, Rajshahi, Patients and Patients attendant	Information meeting with stakeholder regarding service delivery.	MOST	19 Mar 2023	Auditorium, INMAS, Rajshahi

5. Service Rendered

Sl No	Name of service provided	Number/quantity of sample/patient/service	Revenue Income (BDT)
a	Patient service	49963	3,99,86,990/-
b	Sample Analysis(blood)	66051	

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**1. Clinical Services****1.1 Diagnostic**

Both In-vivo and In-vitro techniques are used in this Institute for diagnosis of diseases.

In-vivo technique

The following tests are performed here for diagnosis of various diseases.

- Thyroid Scan: This test is performed with thyroid scanner to determine the function of thyroid gland.
- Nuclear Imaging: Diseases of bone, brain, liver, kidney, thyroid gland etc. are detected by taking images of the respective organs with Dual Head SPECT.
- BMD: Bone Mineral Densitometry (BMD) is used to assess bone mineral content of the patient for detection of osteoporosis and osteopenia.
- Renogram: This test is performed with SPECT machine to determine the functional status of kidneys.

- 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.

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.

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.

1.2 Therapeutic

Radioactive Iodine (I-131) is used for treatment of thyrotoxicosis and thyroid cancer patient.

2. Repair & Maintenance, Renovation Work(s)

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.

3. Budget allocation, Release & Source of fund & centre/institute wise budget allocation

Budget of Financial year 2022-23 : Salary and Allowences = 164.00 Lacs and R&D = 64.00 Lac (Total = 228.00 lacs)

4. Manpower Development

Sl. No.	Title (training program/workshop/seminar/ symposium/ conference)	Date	Place	No. of participant
a)	Training Course on PPR-2008 and Public Procurement Management	10-20 October, 2022	TI, AERE, Savar, Dhaka	01

5. Seminar/Symposium/Conference/Workshop/Meeting Attended

Name of the participant	Title of the event	Organizer	Date	Place
a) Prof. Dr. Ashoke Kumar Paul, Member, Bio-Science, Bangladesh Atomic Energy Commission. Dhaka. e) Prof. Dr. Md. Momenul Haque, Principal, M Abdur Rahim Medical College, Dinajpur. b) Prof. Dr. Shamim Momtaz Ferdousi Haque, Director, NINMAS, Dhaka. d) Dr. B. K. Bose, Director, INMAS, Dinajpur. f) Dr. Md. Fazlur Rahman, Superintendent, General Hospital, Dinajpur. g) Dr. A H M Borhan-Ul-Islam Siddiki, Civil Surgeon, Dinajpur. c) Prof. Dr. Hosne Ara Rahman, Director, INMAS, Mitford, Dhaka. h) Dr. Pupree Mutsuddy, PMO, NINMAS, Dhaka. i) Dr. Tapati Mandal, SMO, NINMAS, Dhaka j) Dr. Tanvirul Hasan, MO, INMAS, Dinajpur	Scientific Seminar & Inauguration Program of Parathyroid Scanning & Lymphoscintigraphy	Society of Nuclear Medicine Bangladesh	05 November 2022	Auditorium INMAS, Dinajpur

Name of the participant	Title of the event	Organizer	Date	Place
k) Dr. Md. Khayerul Alam, MO, INMAS, Dinajpur l) Dr. Shahely Arjuman Ara, MO, INMAS, Dinajpur and other elite person of Dinajpur.				
Dr. B. K. Bose, Director, INMAS, Dinajpur. (Resource Person)	International Conference on Lung Health-PULMOCO N 2023	Lung Health-PULMOCO N	15 & 16 February 2023	Bangabandhu International Conference Centre, Dhaka.
Dr. B. K. Bose, Director, INMAS, Dinajpur. (Resource Person)	Orientation on Diagnosis of TB by Chest Radiography	DGHS	17 January 2023	Hotel X, Index Plaza, Rajpara, Rajshahi.
Dr. B. K. Bose, Director, INMAS, Dinajpur. (Resource Person)	Orientation on Diagnosis of TB by Chest Radiography	DGHS	28 January 2023	Hotel Naz Garden, Bogura.
Dr. B. K. Bose, Director, INMAS, Dinajpur and all members of SNMB	26 th National Conference	Society of Nuclear Medicine Bangladesh	10 March 2023	BRAC Learning Centre, Dinajpur
Dr. B. K. Bose, Director, INMAS, Dinajpur. (Resource Person)	One day Orientation and Discussion on TB & Childhood TB	DGHS	21 May 2023	Hotel Naz Garden, Bogura.

6. Stakeholder Meeting

- Prof. Dr. Ashoke Kumar Paul, Member, Bio-Science, BAEC, Dhaka. 05-11-2022
- Prof. Dr. Shamim Momtaz Ferdousi Haque, Director, NINMAS, Dhaka. 05-11-2022

7. Service Rendered

Sl. No.	Name of service provided	Number/quantity of sample/patient/service	Income (if any)
a	Patient Service	1048	2,09,600/-
b	Sample Analysis (including blood sample)	8105	56,73,500/-
c	Thyroid Scan, Ultrasonography and others	5125	53,98,660/-
Total		14278	1,12,81,760/-

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.

Activities

1. Research and Development Work(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

Sl. No.	Title (training program/workshop/seminar/symposium /conference)	Date	Place	No. of participant
a)	APA Training programme	07/09/2022 15/12/2022 09/03/2023 15/06/2023	INMAS, Rangpur.	13 13 13 13
b)	Industrial Training programme Diploma-in-Engineering for the Department of Electro-Medical .	12 week, 10/10/2022 to 10/01/2023	INMAS, Rangpur.	10

3. Seminar/Symposium/Conference/Workshop/Meeting Attended

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
	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)			
	10. 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, march 2021, 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 Radiosynovecctomy Agents. 2. Clinical Training on High Grade Color Doppler Ultrasound 3. Nuclear Technology Seminar-2019: Basic Radiation Knowledge for School Education Course. 4. Operation & Clinical Training on Dual Head Spect-CT	IAEA Project IAEA Training	14-18 November, 2016 19-31, August, 2019 24 October-08 November-2019 08-21/ May 2022	Quezon City in Philipines India Japan 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, march 2021, 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. Chincinal and Operational Training on Bone Mineral Densitometry (BMD) at Medilink, 393 Rue Charles Lindbergh, 34130 Mauguio.	Project	18-24 November 2019	France
	2. Assessment of Socio demographic status of thyroid cancer patient at institute of Nuclear Medicine & Allied sciences, Rangpur. (Journal of Rangpur Medical College, Vol-6, march 2021, P7-10, ISSN-2618-0413) 3. 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, Hungry
Mr. Md. Wares Ali, Technical Officer	Operational Training program of the Single Head Gamma Camera.	Project	24-28 June 2019	Hungary.

4. Stakeholder Meeting

Establishment of good governance by the Stakeholders’ participation meeting held at the hall of INMAS, Rangpur 12 March/2023. Chief guest honorable Additional Secretary (Admin.) Mr. Rekha Rani Balo.

5. Service Rendered

SI No.	Number of service provided	Number of patients	Revenue income
(a)	Patient Service	19313	1,15,00,500.00
(b)	Sample Analysis(including blood sample)	12517	75,40,500.00
Total		31830	1,90,41,000.00

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

Activities**1. Research and Development Work(s)**

- Correlation of Vitamin D, Parathyroid Hormone and Bone Mineral Density in Healthy Young adult.
- Can we replace Radioiodine uptake test with percentage thyroid scan uptake in Hyperthyroid patient.

2. Academic Activities

- Arranged Seminar on Nuclear Medicine, Ultrasound procedures and related subjects with Doctors & Technologists each month.

Publications: National

- S M Nazim Uddin, Ashoke Kumar Paul, Jharna Das, Md N Nowsher, Drubo Kumar Mondol, A Mazid, Md. N Hossain, Ashima Pervin, Shahriar Muttakin, Tuba Ul Zannat Mou and Mehnaz Riffat, “Diagnostic Dilemma of Lateral Cystic Neck Mass in Children – A Case Report”, Bangladesh Journal of Ultrasonography 23 (1,2); P 30-33.

2. Manpower Development

Sl. No	Title (training program/ workshop/ seminar/ symposium/ conference)	Date	Place	No. of participant
a)	Scientific Seminar on Myocardial Perfusion Imaging (MPI)	24/06/2023	INMAS, Khulna	80

3. Seminar/Symposium/Conference/Workshop/Meeting Attended

Name of the participant	Title of the event	Organizer	Date	place
Dr. Md. Shahriar Muttakin	Carotid Doppler Workshop	BSU	29 th July, 2022	Dhaka
Dr. Jharna Das	“তথ্য অধিকার, অভিযোগ প্রতিকার ব্যবস্থা ও জিআরএস সফটওয়্যার” এবং “সেবা প্রদান প্রতিশ্রুতি” বিষয়ক প্রশিক্ষণ	BAEC	29 th Sept, 2022	BAEC HQ Virtual
Dr. Tuba-Ul-Zannat Mou, Dr. Md. Shahriar Muttakin	34 th National Conference of The Bangladesh Society of Ultrasonography	BSU	28 th Oct, 2022	Hotel Intercontinental, Shahbag, Dhaka
Dr. S. M. Nazim Uddin	“তথ্য অধিকার, অভিযোগ প্রতিকার ব্যবস্থা ও জিআরএস সফটওয়্যার” এবং “সেবা প্রদান প্রতিশ্রুতি” বিষয়ক ২য় ত্রৈমাসিক প্রশিক্ষণ	BAEC	08 th Dec, 2022	BAEC HQ Virtual
Dr. Tuba-Ul-Zannat Mou, Dr. Ashima Pervin, Dr. Mehnaz Riffat Mou	Course on Ultrasound in Obstetrics and Gynecology	GE HealthCare	27 th -28 th Jan, 2023	Radisson Blu Dhaka Water Garden
Shaikh Zahidul Islam	এপিএ লক্ষ্যমাত্রা নির্ধারণ, বাস্তবায়ন ও প্রমাণক সংরক্ষণ পদ্ধতি বিষয়ে লার্নিং সেশন	BAEC	20 th Feb, 2023	BAEC HQ Virtual

Name of the participant	Title of the event	Organizer	Date	place
Dr. Jharna Das, Md. Mahbubur Rahman, Dr. Tuba-Ul-Zannat Mou, Dr. Ashima Pervin, Dr. S. M. Nazim Uddin, Dr. Mehnaz Riffat Mou, Dilip Kumar Bhadury, Md. Billal Shaikh	26 th National Conference of Society of Nuclear Medicine, Bangladesh	SNMB	10 th -11 th Mar, 2023	BRAC Learning Center, Dinajpur

4. Paper presented in Seminar/Symposium/Conference/Workshop

- Low Parathormone Level Following Total Thyroidectomy – Observation of Patient Traits in A Single Institute”, Tuba-Ul-Zannat Mou, Jharna Das, Md. Nazmul Hossain, S. M. Nazim Uddin, Ashima Pervin, Md. Abdul Mazid, Mehnaz Riffat, Md. Shahriar Muttakin and Md. Mahbubur Rahman, 26th National Conference of Society of Nuclear Medicine, Bangladesh on 10-11 March 2023.
- “Long Metastases in Differentiated Thyroid Carcinoma Children – A Case Report of Three Patients”, S M Nazim Uddin, Ashoke Kumar Paul, Jharna Das, Md. Nazmul Hossain, Tuba-Ul-Zannat, Ashima Pervin, Md. Abdul Mazid, Mehnaz Riffat, Md. Shahriar Muttakin and Md. Mahbubur Rahman, 26th National Conference of Society of Nuclear Medicine, Bangladesh on 10-11 March 2023
- Myocardial Perfusion Imaging (MPI)”, Dr Jharna Das, Power Point presented on weekly Scientific Seminar in Khulna Medical College Hospital, 17 January, 2023.
- “Bone SPECT/CT: State-of-the art in Oncology”, Dr. Jharna Das, Power Point presented on weekly Scientific Seminar in Khulna Medical College Hospital, 09 May, 2023 “Bone SPECT/CT: State-of-the art in Oncology”, Dr. Jharna Das, Power Point presented on weekly Scientific Seminar in Khulna Medical College Hospital, 09 May, 2023

5. Service Rendered

Number of patients	Income (BDT)
43,496	2,91,94,870/-

INSTITUTE OF NUCLEAR MEDICINE AND ALLIED SCIENCES (INMAS), BARISHAL

Objective

The Institute of Nuclear Medicine and Allied Sciences, Barishal is situated in the campus of Sher-e-Bangla Medical College & Hospital. It was established in the year of 1989 with the objective to serve the people of the southern most part of the country. The Institute delivers its services 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. The Institute is equipped with one dual head SPECT, BMD, thyroid uptake system, one biochemistry analyzer and three ultrasonography machine with Colour Doppler, Elastoscanner and 3D/4D facilities and a RIA Laboratory. The Institute supplies amniotic membrane for burn patients & bone chips for orthopedic injury.

Activities

1. Patient Service

1.1 Diagnostic Activities

Ultrasonography & Color Doppler : Ultrasonography is the main diagnostic tool of the Institute. Almost 50% of patients are handled through this system. Routine ultrasonography of abdominal organs, HRUS of thyroid gland, pediatric brain, testes, mammary gland, eye ball, joints, musculoskeletal system etc. are highly

popular among the referring physicians. Colour doppler study of the peripheral vessels, carotid arteries, other organs and obstetric doppler ultrasonography are being done routinely. Elastocan, endocavitary scan and 4D Ultrasonography of fetus & different organs are also done here.

RIA laboratory : Serum T₃, T₄, TSH, FT₃, FT₄, FSH, LH, Prolactin, Progesterone, Testosterone, Thyroglobulin (Tg), Anti TgAb, TPO Ab, TRAb, TMAb are confidently estimated weekly and fortnightly.

Biochemistry analyzer : Serum calcium, serum creatinine and other biochemical analysis are done routinely.

BMD - Bone mineral density is done to detect the bone density.

Scintigraphy : Bone scan, Renal scan, Renogram, Liver-spleen scan, Hepatobiliary scan, Meckel's Scan, Thyroid scan and whole body ¹³¹I scans are routinely done.

Radioiodine thyroid uptake is done to evaluate thyroid functional status.

1.2 Therapeutic activities

- I-131 therapy: I-131 therapy is given to Hyperthyroid & Ca- thyroid patients.
- Follow-up: Toxic & Ca-thyroid patients are followed up periodically for the rest of their lives.
- Beta-radiation: Beta-radiation is applied to postoperative Pterygium patients using Sr-90 source.

2. Research and Development Work(s)

- Outcome of radioiodine therapy in well differentiated Ca thyroid patients.
- Pathologies found in high resolution neck Ultrasonography- going on.

3. Repair and Maintenance

A 4D colour doppler ultrasound machine, a BMD machine a thyroid uptake system has been installed by BAEC for INMAS Barishal.

4. Manpower Development

Title (training program/workshop/seminar/symposium/conference)	Date	Place	No. of participant
Arranged In-house Training for Officer & Staff INMAS, Barishal	30 August, 2022 23 November 2022 14 March 2023	INMAS, Barishal	Officers = 09 Staff =18
Arranged Seminar for Stakeholders, doctors (SBMCH & INMAS), officers & staff for good governance	17 September 2022	INMAS, Barishal auditorium	Related doctors officers & staff

5. Seminar /Symposium/Conference/Workshop/Meeting Attended

Name of the participant	Title of the event	Organizer	Date	Place
i) Dr. Nafisa Jahan CMO & Director	a) APA Target, Implementations, Evidence storing system related learning sessions	BAEC	20 January 2023	Zoom platform
	b) 26 th National Conference of Society of Nuclear Medicine Bangladesh	SNMB	10-11 March 2023	Dinajpur
	c) APA meeting	BAEC	12 June , 2023	BAEC , HQ Dhaka
	d) APA 4 th third quarter coordination meeting	BAEC	19 June 2023	Zoom platform
iv) Dr. Md. Sabbir Hossain, MO	a) Right of Information and remedy of dispute & GRS software	BAEC	08 December 2022	Zoom platform

Name of the participant	Title of the event	Organizer	Date	Place
v) Md. Mahotav Uddin Alhmahomud, AO	a) APA Target, Implementations, Evidence storing system related learning sessions	BAEC	20 January 2023	Zoom platform
	b) APA 4 th third quarter coordination meeting	BAEC	19 June 2023	Zoom platform

6. Stakeholder Meeting

(1) Stakeholder meeting arranged by INMAS, Barishal on Establishing dispute prevention & good governance in the INMAS, Barisha auditorium on 20 August 2022.

(2) Stakeholder meeting arranged by INMAS, Barishal on Establishing citizen charter in the INMAS, Barishal auditorium on 10 September 2022.

7. Service Rendered

Sl. No	Number of service provided	Number/quantity of sample/patient/service	Revenue income
a)	Patient service including blood sample analysis	37024	2,07,97,760/-

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, Comilla 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.

- Nuclear scanning /Scintigraphy
- Thyroid Division
- In-vitro Nuclear Medicine
- Therapeutic Nuclear Medicine
- Ultrasound division

Activities

1. Patients service

Principal activities of the institute is to render diagnostic and therapeutic service to the patients. A large number of patients attend the institute for ultrasonogram, thyroid function studies, radioisotope scan and for estimation of different hormones. The institute also render therapy for thyrotoxicosis and ca-thyroid patients.

2. Research and Development Work(s)

The institute has been doing number of research works in the discipline of ultrasound and nuclear medicine. Few of the undergoing works are mentioned below-

- Duplex study of inferior thyroid arteries and correlation with biochemical status.
- Prevalence of fatty liver and pancreas—an ultrasound study.
- Ultrasound evaluation acute appendicitis and clinical correlation.

3. Manpower Development

- Scientific training on : “Basic Nuclear Medicine and Administration” for officers and staff organized by INMAS, Faridpur 10-17 June, 2023.
- Dr Afrida Khanom MO, started her MD Nuclear Medicine course in 2022.

4. Seminar/Symposium/Conference/Workshop/Meeting Attended

Name of the participant	Title of the event	Organizer	Date
a) Professor Dr. Hafizur Rahman (Director)	Thyroid Ultrasound Elastography : A Promising Undeniably Diagnostic Tool for Predicting the Risk of Malignancy,	BSMMCJ	Vol: 01/07/2022

5. Service Rendered

Sl. No.	Name of service provided	Number/quantity of sample/patient/service	Revenue income
a	Patients Service including Ultrasound Doppler, Scintigraphy, Radioiodine therapy	11200	1,57,22,800/-
b	Blood sample and analysis	16792	
Total		27992	1,57,22,800/-

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 equipments are available in this institute.

Activities**1. Manpower Development**

Sl. No.	Title (training program/ workshop/ seminar/ symposium/conference)	Date	Place	No. of participant
1	কর্মকর্তা-কর্মচারীগণের অংশগ্রহণে শুদ্ধাচার বিষয়ক প্রশিক্ষণ	15/09/2022	INMAS, Bogura	35
2	কর্মকর্তা-কর্মচারীগণের অংশগ্রহণে শুদ্ধাচার বিষয়ক প্রশিক্ষণ	06/12/2022	INMAS, Bogura	34
3	কর্মকর্তা-কর্মচারীগণের অংশগ্রহণে শুদ্ধাচার বিষয়ক প্রশিক্ষণ	14/03/2023	INMAS, Bogura	35

2. Seminar/Symposium/Conference/Workshop/Meeting Attended

Name of the participant	Title of the event	Organizer	Date	Place
a) Dr. Md. Abdul Awal	The Bangladesh Society of Ultrasonography, (BSU) National 34 th Conference	The Bangladesh Society of Ultrasonography, (BSU)	28/10/2023	Dhaka
b) Dr. Sunny Anam Chowdhury				
c) Dr. Suraya Sarmin				
d) Dr. Al Mamun				
a) Md. Faruk Hossin	Workshop on Monte Carlo Simulation for Medical Physics Application	INMP	13/02/2023 - 14/02/2023	AERE, Dhaka

Name of the participant	Title of the event	Organizer	Date	Place
a) Dr. Md. Abdul Awal	26 th National Conference-SNMB	SNMB	10/03/2023 - 11/03/2023	Dinajpur
b) Md. Faruk Hossain				
c) Dr. Al Mamun				
d) Dr. Nazia Tarannum				
e) Md. Zillur Rahman				
f) Md. Arman Ali				
g) Md. Abdus Sobhan Akanda				
h) Md. Abdul Matin				
i) Md. Tarik Hossain				
j) Md. Jamirul Haque				
k) Md. Mizanur Rahman				

3. Stakeholder Meeting

1	Stakeholder Meeting	16/11/2022	INMAS, Bogura	07
2	Stakeholder Meeting	10/06/2023	INMAS, Bogura	00

4. Service Rendered

Sl. No.	Name of service provided	Number/quantity of sample/patient/service	Income (Tk)
a	Patient Service	16966	81,26,780/-
b	Sample Analysis (including blood sample)	18899	1,33,01,880/-
Total		35865	2,14,28,660/-

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 is one of them. INMAS, Cumilla is established in 1996, which is located at Cumilla Medical College Campus. This institute provides diagnostic and therapeutic treatment service by using nuclear medicine technique, Ultrasound & Color duplex. Cases of the patients from the east part of Bangladesh covering Cumilla, Feni, Noakhali, Chandpur, Laxmipur, Barisal etc.

Activities

1. Research and Development 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 provided in this institute to help the doctors (Outside of BAEC) to improve their skills in Nuclear Medicine.

2. Repair, Maintenance and Renovation Work(s)

“Capacity building project - INMAS, Cumilla” is in progress.

3. Others

Regular follow up for thyroid patients

4. Manpower Development

Sl. No.	Title (training program/workshop/seminar/symposium/ conference)	Date	Place	No. of participant
a)	Skill development training – Clinical training on SPECT & SPECT CT, Radiation & Safety, BMD, Radiology, Radioisotope, Office Management & SDG	16-18 April, 2022	Seminar Room INMAS, Cumilla	21
b)	Training Course on PPR-2008 and Public Procurement Management	10-20 October 2022	Training Institute AERE, Savar, Dhaka	01
c)	Right to Information Act	22-23 May 2023	Seminar Room INMAS, Cumilla	20

5. Seminar/Symposium/Conference/Workshop/Meeting Attended

Name of the participant	Title of the event	Organizer	Date	Place
a) Dr. M. M. Arif Hosen Principal Medical Officer & Director	Training on BMD Machine`	MEDILINK	20-26 September, 2022	Nimes, France
b) Proshanta Kumar Goswami Technical Officer				

6. Service Rendered

Sl. No.	Name of service provided	Number/quantity of sample/patient/service	Revenue income
a	Sample Analysis (blood sample)	20557	21254600/-
b	Others (Renogram, Bone Sc an, Ultrasonogram, Thyroid Scan, Thyroid Uptake & Follow up)	9011	
	Total Patient Service=	29568	

INSTITUTE OF NUCLEAR MEDICINE & ALLIED SCIENCES (INMAS), COX'S BAZAR**Objective**

- Ensuring the safe uses of nuclear medicine in diagnostic and therapeutic procedures.
- Ensuring the 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 technology in medical service.
- Increase research capacity in science and technology.
- To increase transparency and ensure accountability in official activities.
- Bringing dynamism in performance and increasing the quality of service.

Activities

- Providing services by regular follow up of thyroid patients.
- Radio Iodine Therapy.
- Scintigraphy and Ultrasound Services.
- RIA Activities.
- Clinical research in nuclear medicine and thyroid disorders.

1. Manpower Development

Sl. No.	Title (training program/workshop/seminar/symposium/ conference)	Date	Place	No. of participant
a)	Local Workshop (by IMED)	7 May, 2023	INMAS, Auditorium, Cox's Bazar	40

2. Seminar/Symposium/Conference/Workshop/Meeting Attended

Name of the participant	Title of the event	Organizer	Date	Place
a) Dr. Md. Sayeedul Alam	Bangladesh Society of Ultrasonogram Annual Meeting	BSU	28 October, 2022	Hotel Intercontinental, Dhaka
b) Dr. Md. Sayeedul Alam	Bangladesh Thyroid Society Annual Conference	BTS	3 rd March, 2023	BIAM Auditorium, Dhaka

3. Service Rendered

Sl. No.	Name of service provided	Number/quantity of sample/patient/service	Revenue income
a	Patient Service	6932	4438700/-
b	Sample Analysis(including blood sample)	11536	
d	Irradiation of Food/Medical Products		
Total			4438700/-

III. ENGINEERING AND GENERAL SERVICES**ENGINEERING DIVISION (ED), BAEC HQ****Introduction**

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. Under the Charter of Bangladesh Atomic Energy Commission, Engineering Division (ED) has been entrusted with the responsibilities for installation, testing and operation of various scientific, nuclear and engineering facilities and building up & maintenance of physical infrastructures for smooth operation of R&D programs of BAEC. This division is also actively involved in the implementation of “Construction of 2400 MWeRooppur Nuclear Power Project (CRNPP)” at Pabna. Following activities have been performed by Engineering Division during 2022-2023 periods.

Activities**1. Contributions in implementing of various ADP projects of BAEC (Ongoing)**

1.1 Works contributing under the project “Construction of 2400MWeRooppur Nuclear Power Plant” are as following:

- Printing, sound system and stationery & other related works for the installation ceremony of reactor pressure vessel of unit-2 by honorable prime minister at CRNPP, Pabna.
- Event management including networking broadband and other related works for installation ceremony of reactor pressure vessel of unit-2 by honorable prime minister at CRNPP, Pabna.
- Aluminum structure panel, furniture, venue outside & inside Branding works for the inauguration ceremony of reactor pressure Vessel Unit-2 at CRNPP, Pabna.

1.2 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.

- Planning, designing, estimating and construction of eight new buildings at various project sites.

- Supervision and completing finishing works of all new 8 INMAS buildings are in progress.
- Construction, management, supply, installation and commissioning works related to Sub-Stations, Lifts, AC, firefighting, pumps etc.
- 1.3 Planning, designing, estimating and construction of new radiotherapy facilities works under the project “Establishment of Calibration and Quality Control Facilities for Radiotherapy, Diagnostic Radiology and Neutron”.
- 1.4 Various civil/electrical/mechanical works contributed under the project “Establishment of Positron Emission Tomography–Computed Tomography (PET-CT) with Cyclotron facilities” at Mymensingh and Chittagong.
- 1.5 Various civil/electrical/mechanical works contributed under the project “Establishment of Positron Emission Tomography–Computed Tomography (PET-CT) with Cyclotron facilities” at AERE, Savar.
- 1.6 Modernization of the laboratory Facilities of Institute of Electronics.
- 1.7 Various civil/electrical/mechanical works contributed under the project “Balancing, Modernization, Refurbishment and Extension (BMRE) of Safety Systems of the 3 MW TRIGA Mark-II Research Reactor Facilities”.
- 1.8 Strengthening of existing gamma source of Bangladesh Atomic Energy Commission.
- 1.9 Modernization and strengthening of service and research facilities of the Institute of Tissue Banking and Biomaterial Research.
- 1.10 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. Contributions accomplished to various ADP projects of BAEC (Completed)

- 2.1 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.
- 2.2 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.
- 2.3 Works contributed under the project “Capacity build-up of Nano and Nano bio-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.
- 2.4 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.
- 2.5 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”.

- 2.6 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”
- 2.7 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 (2022-2023) 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. Some completed works within the financial year 2022-2023 are given below:

3.1 At BAEC HQ, Dhaka

- Supplying of Tempered Glass Table Top for the Directors Table & Side Table at BAEC, HQ.
- Supplying, Testing and Printing of RFID Proximity MI fare card with Belt & Card Holder at BAEC, HQ.
- Repair, Servicing, Testing and Running of Air Conditioners at Entrance Lobby of Head Office and BAEC, Officer’s Quarter, Banani, Dhaka.
- Supply, Installation and Commissioning of 3KVA Online UPS at BAEC, HQ, Dhaka.
- Supplying, Installation Testing and Commission of Mini Refrigerator and Mini Oven for Member (Engineering) at BAEC, HQ.
- Supply, Installation, Testing and commissioning of Air Conditioner at the office room of Member (Bio Science) & Bio Science Division of BAEC, HQ.
- Supplying of office Furniture for medical clinic and engineering division at BAEC, HQ.
- Regarding the Stall preparation and decoration of Bangladesh Atomic Energy Commission in Amar Kaushey Book Fair 2023.
- Supplying of Venetian Blind and window Repair of Room no-706 at BAEC, Head Quarter, Dhaka-1207.
- Refilling testing fitting fixing a new supply of fire extinguisher cylinder at BAEC HQ, Dhaka.
- Re-Installation and connection of internet lines from 5th Floor server Room to 1st, 2nd and 3rd Floor and purchase of internet switch and re installation of Internet for 2nd Floor at BAEC, HQ.
- Marble Cutting & Cleaning in Ground Floor, Fare face Wall Cleaning in Guard Room and in Front of Main Building (Selected Area), French Polish in Auditorium’s Wall Paneling and wall painting in Fron of Lift in Ground Floor at BAEC, HQ.

3.2 At RNPP SITE

- Printing, Sound system and stationery & other related works for the installation ceremony Honorable Prime Minister for Reactor pressure Vessel of Unit-2 at RNPP, Pabna.
- Event management including networking broadband and other related works on 19.10.2022. The installation ceremony of Reactor pressure vessel of unit-2 by honorable prime minister at RNPP, Pabna.
- Aluminum structure panel, furniture, venue outside & inside Branding works for the inauguration of Reactor Pressure Vessel Unit-2 at RNPP, Pabna.

3.3 At BAEC Housing Colony, Banani, Dhaka

- Renovation/repair and Maintenance works of Boundary wall at BAEC Housing Colony, Banani.
- Regarding Security Guard Room, Guest Room, Guest House, Club Room Flat No C-3, (Sewerage Line Maintenance) Flat no c-6, (Commode Jam Cleaning and other works at BAEC, Housing Colony, Banani, Dhaka.
- Supply, Installation testing of commissioning of Geysers and other relation works for Guest House at BAEC Banani Colony. Dhaka.
- Supply, Installation, Testing and Commissioning of Centrifugal Pump Motor set and related works at Banani Colony, Dhaka.

- Repair, Maintenance with necessary Modification of Flat No: C-02, 04, 07, 10, & C-11 at BAEC, Housing Colony, Dhaka.
- Troubleshooting, Repair, Servicing & Running of a Damaged Condenser Unit (60tr) of Central HVAC system for Cyclotron Installed a NINMAS, Dhaka.

3.4 At AERE and Other campus of BAEC

- Construction of Southside Boundary wall at Atomic Energy Research Establishment (AERE), Savar, Dhaka.
- Renovation/Repair work of VCB of Sub-station at INMAS, Dhaka.
- Feasibility Study of Request for Expression of Interest for Feasibility study of the project establishment of Atomic Energy Centre (AEC), Cox's Bazar.
- Repairing and Servicing of 250 KVA Sub-station of BSMEC at Cox's Bazar and related services.
- Feasibility Study of Capacity Building and strengthening of Atomic Energy Centre, Chittagong.

3.5 At NINMAS & INMAS

- Renovation/Repair work of VCB of Sub-station at INMAS, Dhaka.
- Installation of 3 Phase Meter with 10KW Load Approval of INMAS, Cox's Bazar and related services.
- Supply, Installation, Testing and commissioning of Air Conditioner at INMAS, Dhaka.
- Supply Testing and Commissioning of UPS Battery and other related works at Institute of Nuclear Medicine & Allied Science (INMAS), Dhaka.
- Monthly Maintenance & Servicing of One Passenger Lift (1075kg, Schindler) for the period of two year at INMAS, Khulna.

4. Various engineering services rendered within the financial year 2022-2023 are given below

Engineering Division has been considered as key division of this organization, as it responsible to smoothly operate the overall R&D activities of BAEC by creating various facilities and services. Some services within the financial year 2022-2023 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)National Museum of Science and Technology.

5. Manpower Development

Sl. No.	Training program/workshop/Seminar/symposium/Conference (In house)	Date	Place	No. of participant
1	Training on Self Defense System with GRS software	22/02/2023	Alpha Hall, BAEC, HQ.	2 persons

6. Paper published from Engineering Division

- A mathematical modeling for assessing air pollution (PM10) and public health effects- an alarming scenario over Dhaka city, Md. Salahuddin Sheikh¹ and Toshihiro Kitada², IOSR Journal of Environmental Science, Toxicology and Food Technology (IOSR-JESTFT) e-ISSN: 2319-2402,p- ISSN: 2319-2399.Volume 17, Issue 4 Ser. I (April 2023), PP 25-32

7. Preparation of Development Project Pro-forma (DPP)

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”.
- “Enhance Capacity of Institute of Nuclear Medicine and Allied Sciences (INMAS) at Mitford, Comilla, Faridpur, Barisal and Bogra.”

ENGINEERING AND GENERAL SERVICE DIVISION, AECD

Introduction

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 2022 – 30 June 2023) 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. The electrical section has done various jobs in this reporting period for AECD. A few are –

- 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 the Scientist 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 47 jobs. Installed, repaired and maintained many Air-conditioners of AECD. A few are mentioned below:

- Repair and maintenance of AC in the Experimental Physics and NDT Division.
- A total of 5 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 11 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 34 jobs. A few are mentioned below:

- Repair and maintenance of the water supply line at the Material Science Division (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 flash 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 6 jobs requisition and completed all the works successfully. A few of them are-

- 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 4 glass-related works for AERE, a research student from Jahangirnagar University and Chemistry division.

CENTRAL ENGINEERING FACILITIES(CEF), AERE

Introduction

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.

Activities

1. Construction, Repair, Maintenance, Operation and Renovation Works

1.1 Mechanical Engineering Division

- Supplied drinking water which is used in different Institute of the office side and residential area of AERE colony.
- Installation and servicing works of 1600mm x 150mm deep Tube well with new column pipe and others materials at AERE colony, saver, Dhaka.
- Repaired & maintenance works of 2HP submersible water pump of police camp at AERE campus.
- Installed new 1500 liter water tank on the roof of officer's dormitory at AERE colony.
- Installed 4 nos. new gas meter by the Titus gas and distribution company Ltd. at AERE campus.
- Installed new 6" gate valve for water line of colony submersible pump at AERE.
- Installed, Modification & Commissioning of new 30 HP Capacity Building Service Centrifugal Pump Motor Set, Star Delta Motor Control Panel & Slice Valve /gate Valve including necessary others accessories at AERE Saver, Dhaka.
- Replaced of damage water heater from VIP guest house of room no -1 and installed new 15 letter automatic electric water heater with modification of existing water line.
- Repaired & maintenance works and replacement of damage gas burner and installed new gas burner from different residential building at AERE. Approximately 20 nos. gas burner repaired and new installed 30 nos.
- Repaired & maintenance works of natural gas line and gas regulator, lock wing cock, Uzala key etc. as per requirement of different user at AERE campus.
- Repaired colony side 25 HP centrifugal pumps 3A, 3B & 3C.
- Replacement electric motor of colony pumps 3D.
- Repaired office side 25 HP centrifugal pumps 2A.
- Rewinding and repaired electric motor of office side pump 2B.
- Installation & modification works of ball cock for overhead water tank of colony building at AERE, Saver.
- Repaired of underground water pipe line front of E₂ building at AERE colony.
- Installation and refilling works of fire extinguisher at AERE.
- Checked the gas regulator reading and gas bill at AERE campus.
- Prepared the monthly water bill of Uttra Bank Ltd.
- Painting works has done as per requirement.
- Deign, estimate, parches and implementation of different mechanical works as per requirement.
- Repaired & maintenance works and check of sewerage line at AERE campus.
- Replaced 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.
- Replaced & maintenance work has done of the gas regulator and lock wing cock at AERE campus.
- Routine mechanical maintenance works has done as per requirements of different institute.

1.2 Electrical Engineering Division

- Supervision of repair & maintenance works with necessary modification of laboratory & sitting rooms of food safety and quality analysis division [S-103, S-105, S-105(A),S-106, 107, S-109, S-110, S- 206, S- 207, S-213] and laboratory room (beside S-207 room) at AERE.
- Supervision works of construction of rearing house for VDRAD at AERE.
- Supervision of repair & maintenance with necessary modification works of reactor and neutron physics division (room No. 119, 139, 140, 142, 143, 144, 145, 146, 147, 148, 149, 221, 214) and corridor, INST at AERE.

- Supervision of repair & maintenance with necessary modification works of nuclear and radiation chemistry division laboratory (room no.213), INST at AERE.
- Supervision of repair & maintenance works with necessary modification of two laboratories in plant biotechnology and genetic engineering division, IFRB, AERE.
- Supervision of repair, maintenance and renovation works of high performance germanium detector laboratory, Isotope hydrology division (Room no.116A) with necessary modification INST at AERE.
- Installation of 08 nos. New LED panel light 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.
- Installation of circuit breaker & power socket VIP guest house 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 acarology 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 main distribution board in all institute and residential colony at AERE.
- Repaired and maintenance of HT & LT power supply in all institute and residential colony at AERE.
- Verifying of electricity bill at AERE.
- Repaired and maintenance of 40 nos. Three phase and single-phase circuit breaker for laboratory instrument and air condition power supply in all institute at AERE.
- Replacement of 15 KVA Pole mounted transformer use only in DG Banglo residential colony at AERE.
- Repaired 45 nos. ceiling fan of INST, IFRB, CAD, ICS, TI, Police camp at AERE.
- Repaired 500 nos. ceiling fan of quarter no.C-1, C-2, C-3, D-2, E-1, E-2, E-3, F-1, F-3, officer hostel staff hostel, Tin shed house at AERE.
- Installed of 45 nos. new ceiling fan in all institute and AERE residential colony at AERE.
- Installed of 10 nos. new exhaust fan in all institute and AERE residential colony at AERE.
- Repaired and maintenance of 32 nos. building security light in AERE office and residential colony at AERE
- Repaired and maintenance of 22 nos. street light in AERE Office and residential colony.

1.3 Civil Engineering Division

- Repair & maintenance Work of Quarter Nol. F-1/4, F-1/5, F-1/6, F-1/7, F-1/8, F-1/16, F-2/10, F-2/12, F-2/13, F-2/15, F-2/16, F-2/17, F-3/5, F-3/8, F-3/15, F-3/16, F-3/19, F-3/20, E-2/5, E-4/18, D-1/7, Officers' Hostel/Dormitory No. 118, 305, 306, 307, 309 at AERE Housing Colony, Savar, Dhaka.
- Repair & maintenance work of drivers' waiting room building and police camp at AERE.
- Repair & maintenance with necessary modification of NRCD lab (#213) at INST, AERE,
- Construction work of front side floor for protect rain water of Uttara Bank at AERE, Savar, Dhaka.
- Provided cut the existing Bricks wall with others for new solar cell laser cutter machine placing in the laboratory room at Institute of Energy Building 1st floor under Improvements and modernizations of the laboratory facilities of institute of electronic project at AERE.
- 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, AERE.
- Repair, maintenance & modification work of room no. 137-D of NRCD, INST, AERE.
- Installation of building number of different institute and facilities at AERE.

- Repair, maintenance works of RCC (SLAB) palisading guide wall surrounding CAD building at AERE.
- Construction of guiding support and soil filling for road conservation at AERE.
- Construction of incomplete works of 1st floor (part) of AERE School & college administrative building with roof top treatment works at AERE.
- Construction of common room (part) two storied works of AERE School & College administrative building with roof top treatment works at AERE.
- Renovation/repair and maintenance works of institute of energy science building at AERE.
- Preparation the estimate and costing of various renovations, repair& maintenance of civil works at AERE.
- Construction to be continue of south side boundary wall at AERE.

1.4 Central Engineering Workshop Division

- Installation of Bangabandhu Sheikh Mujibur Rahman & Prime minister Sheikh Hasina's Picture in the every director room of different institute at AERE
- Repair & maintenance works of window glass, door lock, haze-bolt, door frame and shutter for different institute at AERE.
- Made of wooden box for collecting rain water sample and send to IAEA, Vienna, Austria through Isotope Hydrology Division of INST at AERE.
- Installation of building number plates in AERE all KPI Building as required by IAEA.
- Supply of table glass for different institute at AERE.
- Made of steel mold (12 Pcs.) NRCD non-RCA project RAS-1024 of INST at AERE.
- Repair steel door of Tandem accelerator facilities at INST.
- Installation of wooden main door with necessary fitting of office side, different building and residential colony at AERE.
- Made of steel rack for laboratory research work of different institute at AERE.
- Perform machining, welding, sheet-metal works, carpentry works etc. as per requisition from different institute at AERE.
- Repair & maintenance works of Training Institute and Auditorium at AERE.
- Made of stand for filling liquefied Nitrogen in the HPGe Detector of the Isotope Hydrology Division, INST at AERE.
- Repair of Aluminum glass door frame of INST main gate, east & south gate INST at AERE.
- Broken gate of temporary Radioactive Waste storage room of CRR, at AERE.
- Repair & maintenance works of VIP guest house door (room-04) at AERE.
- Made of three Iron stands on urgent basis for installation of Rainfall collector for Isotope Data collection of rainfall in Sylhet region of Isotope Hydrology Division, INST at AERE.
- Door Locks have been installed on some doors of various office rooms and on some floors of officer's hostel at AERE.
- Made of Spare parts of 3D printer in Nuclear Electronic Division IE at AERE.

1.5 Air conditioning Division

- Installation of 6 (six) nos. new split and window type Air cooler (2 ton & 1.5 ton) at INST, INMP, IFRB, IE, ICS, & CAD building.
- Routine service around 197 nos. of window & split type Air cooler in all institutes at AERE.
- Repair 32 nos. of window & split type Air cooler at INST, IFRB, TI, IE, VIP guest house, ICS, CRR, IES, TAD, Cafeteria, INM, CAD building & SIU.
- Repair other refrigeration systems (Cooling incubator, Dehumidifier etc.) at AERE different laboratory.
- Operation, repair & maintenance the central Air Conditioning Plant of INST Auditorium.

- Replaced around 10 Nos. blower's motor of window & split type Air cooler in different institutes at AERE.
- Replaced around 08 Nos. compressor of window & split type Air cooler in different institutes at AERE.
- Replaced around 07 Nos. magnetic contactor of window & split type Air cooler in different institutes at AERE.
- Replaced around 06 Nos. indoor and outdoor circuit of window & split type Air cooler in different institutes at AERE.
- Replaced around 09 Nos. capacitor of window & split type Air cooler in different institutes at AERE.
- Replaced around 05 Nos. overloads, relay of window & split type Air cooler in different institutes at AERE.
- Fitting fixing of capacitor and gas charged of window & split type Air cooler in different institutes at AERE.
- R-22, R-410A, R-12 gas charged of total 11 nos. refrigerators, window & split type Air cooler and fridge in all institutes at AERE.

IV. INTERNATIONAL AFFAIRS DIVISION (IAD), BAEC HQ

Introduction

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 liaisons are bordered normally to the nuclear technology transfer, enrichment of nuclear instrumentation, establishing nuclear power plants and development of human resources for the peaceful application of nuclear science & 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 implementing projects. 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 and administration personnels. In the financial year 2022-2023, IAD has processed nominations of approximately 118 participants for various Online international programme in different countries (except India & Russia). IAD also works to arrange expert missions, international meetings, workshops, seminars, trainings, etc. in BAEC as well as in the country. To enhance R&D (Research and Development) works, IAD plays an important role to execute bilateral and multilateral agreement with foreign countries. 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, 2022 – June, 2023" is presented below:

Activities

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.

1.1 Technical Cooperation (TC) projects

In the financial year 2022-2023, IAD worked for five (05) ongoing TC projects and simultaneously to obtain new TC projects in different priority fields of development perspective of the country. The TC projects are

covering the thematic areas on Establishing Nuclear Power, Nuclear Agriculture, Human Health (nuclear medicine), Environment and Water resources.

1.2 Regional Cooperative Agreement (RCA) Projects

RCA is an intergovernmental agreement among IAEA member states of East Asia and Pacific region. The projects among the twenty two 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 Twelve (12) RCA projects covering different nuclear fields namely- Agriculture, Human Health, Industry, Environmental Protection and Water Resources.

1.3 Non- RCA Projects

These projects are Asia Region Based projects supported by IAEA Technical Cooperation (TC). In these projects, countries from Middle East are also involved with the twenty two RCA countries. In the reported year, IAD made liaison for Thirty one (31) 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.

1.4 Coordinated Research Projects (CRPs)

Bangladesh avails IAEA research supports through the Coordinated Research Projects (CRPs) too. Such research activities are normally conducted by the research institutes of both the developing and developed countries those are member of IAEA on the same research area of interest. IAEA funds a portion of the project's cost, IAD liaisons for a number of Fifteen (15) CRP projects covering the research area of Food and Agriculture, Human Health, Physical and Chemical Sciences, Nuclear Installation Safety, Nuclear Fuel Cycle, Nuclear Security Culture and Waste Technology Besides BAEC, scientific institutes and Universities of Bangladesh such as ICDDR,B, Dhaka University, Bangladesh Agricultural University (BAU), Radiation Oncology Department of the Hospitals Centre for Woman and Child Health, are involved with CRPs.

2. 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 2022-2023, IAD made liaison for a number of Seven (7) FNCA projects.

3. Exchange of experience and expertise

Exchange Programs under the Ministry of Education, Culture, Sports, Science and Technology (MEXT) and Nuclear Safety Research Association (NSRA) of Japan invite nuclear researchers from neighboring Asian countries to Japan and dispatches Japanese experts to other countries. As the focal point of this program, IAD processed the necessities 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 grade research activities in Japan for contributing to build up and to strengthen nuclear base and nuclear safety works in BAEC.

4. Follow-up Training Course (FTCs) Instructor Training Courses (ITCs), Advance Instructor Training Courses (AITCs) and Online Training Courses (OTCs)

During the reported period, three Follow-up Training Courses (FTCs) are conducted in Dhaka with the help of Japanese and Bangladeshi experts. Through the FTCs Sixty Three (63) participants are trained in different areas of nuclear science and technology. About Twenty Two (22) participants have completed ITC, AITC & OTC during the period.

5. Service Training

In case of the appropriate set up/operation of procured new nuclear instruments specially, under ADP Projects, IAD works to complete the service training processes in order to avail them in the instrument manufactures.

6. 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, ANSN etc. Officials from BAEC, MoST and other organizations have attended conferences, meetings, workshops and have availed significant number of fellowships and trainings in the reported period under TC, RCA and FNCA projects.

V. NUCLEAR POWER AND ENERGY DIVISION (NPED), BAEC HQ

Introduction

Nuclear Power and Energy Division (NPED) is one of the most important divisions of the Bangladesh Atomic Energy Commission (BAEC). NPED is playing a vital role in implementing the nuclear power program in Bangladesh. 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. NPED is playing an important role in the assessment of the primary energy mix and assessing the possibility of implementing nuclear power projects in Bangladesh. This division is also assisting in selecting another site for the nuclear power plant in the southern region of Bangladesh.

Activities

Regarding the implementation of the “Construction of Rooppur Nuclear Power Plant (RNPP) Project”, activities namely, Incoming Control Inspection at RNPP Construction Site for Long Term Manufacturing Equipment (LTME) and Supply Equipment (SU) (Non-LTME); Reviewing the achievement of milestones in Long Term Manufacturing Equipment (LTME) and Supply Equipment (SU) (Non-LTME); Coordinating with Indian experts regarding consultancy services in the construction of ‘Rooppur NPP’; and Reviewing Plan of Licensing and Permitting Activities at the Stages/Sub-Stages of Construction and Commissioning of ‘Rooppur NPP’ were cooperated by this division during this fiscal year.

Works related to the preparation of the DPP for the establishment of the ‘National Nuclear and Radiological Emergency Management Center (NNREMC)’ were cooperated from this division. This division is also collaborating in the ‘Study Team’ of BAEC for the IAEA project titled ‘Analysis Support for Enhanced Nuclear Energy Sustainability Pilot Study on Sustainable Deployment Scenarios for Small Modular Reactors (ASENES SMR)’. The background information on the status and development of nuclear power programs in Bangladesh was also updated in the ‘Country Nuclear Power Profiles’, IAEA, from this division. Besides, research works related to the analysis of nuclear safety, and the reliability assessment of safety class equipment for nuclear power plant have been performed in this division during this fiscal year.

1. Seminar/Symposium/Conference/Workshop/Meeting Attended

Name of the participant	Title of the event	Organizer	Date	Place
Mr. Mahmud Hossain	Inspection of the Manufacturing of LTME for the construction of Rooppur Nuclear Power Plant.	RNPP Project	15 November, 2022 -12 February, 2023	Russian Federation
Dr. Muhammed	Interregional Training Course on Nuclear Power Plant Financing and Risk Allocation.	IAEA and Argonne National Laboratory	03-07 October, 2022	Lemont IL, United States of America

Name of the participant	Title of the event	Organizer	Date	Place
Mufazzal Hossen	Technical Meeting of Analysis Support for Enhanced Nuclear Energy Sustainability Pilot Study on Sustainable Deployment Scenarios for Small Modular Reactors (ASENES SMR).	IAEA	11-14 April, 2023	Vienna, Austria

VI. CONSTRUCTION OF ROOPPUR NUCLEAR POWER PLANT PROJECT (CRNPP)

Introduction

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 to transform Bangladesh into developed nation. It will help in ensuring energy security and achieving energy independence of the nation.

1. Activities

1.1. Manpower Development

Sl. No.	Title (training program/workshop/ seminar/ symposium/ conference)	Date	Place	No. of participant
I.	Training on “Self-assessment of Emergency Arrangement and Use of EPRIMS	21-25 May, 2023	BAERA	06
II.	International Conference on Electronics and Informatics 2022	26-28 January, 2023	AEC, BAEC	08
III.	47th Understanding Training on ISO/IEC 17025:2017- General requirements for the competence of Testing and Calibration Laboratories	3-5 June, 2023	Anex Building, Ministry of Industry	04
IV.	Training on “Reactor Engineering”	22 February- 02 March 2023	AERE, BAEC	08
V.	Training on “Nuclear and Radiological Emergency Preparedness” and “Environmental Radioactivity Monitoring”	15-19 June, 2023 and 10-21 September, 2023	AERE, BAEC	07
VI.	Training on ‘Chemical Shop’	17 September 2022- 6 May 2023	Russian Federation	14
VII.	Training on ‘Radiation Safety’	17 September 2022- 21 April 2023	Russian Federation	16
VIII.	Training on ‘Reactor Shop’	1st Oct 2022- 21 April 2023, 27 March 2023- 3 October 2023 and 28 April 2023- 5 November 2023	Russian Federation	24

Sl. No.	Title (training program/workshop/ seminar/ symposium/ conference)	Date	Place	No. of participant
IX.	Training on 'APCS & EE Services'	14 November 2022-28 March 2023, 12 December 2022-19 June, 2023 & 1 April 2022-13 December 2023	Russian Federation	20
X.	Training on 'APCS & EE Services' (Electrical Shop)	5 December 2022- 25 April 2023	Russian Federation	06
XI.	Training on 'APCS & EE Services' (Electronic Shop)	15 October 2022-2 March 2023	Russian Federation	09
XII.	Training on 'APCS & EE Services' (I&C Shop)	5 December 2022- 18 April 2023	Russian Federation	04
XIII.	Training on Centralized Repair Shop	20 February 2023-11 July 2023	Russian Federation	19
XIV.	Training on 'Maintenance & Repair Shop'	28 April 2022-13 September 2023	Russian Federation	13
XV.	Training on 'Maintenance & Repair and Instructor'	28 April 2022-13 September 2023	Russian Federation	13
XVI.	Training on 'Maintenance & Repair'	16 May 2022-17 September, 2023	Russian Federation	06
XVII.	Training on 'Operation (Turbine Shop)	03 October 2022- 21 November 2023	Russian Federation	09
XVIII.	Training on 'Raw Treatment Shop'	7 February 2023- 24 July 2023 & 22 February 2023-8 August 2023	Russian Federation	14
XIX.	Training on 'Reactor Operator'	17 June 2023-21 December 2023	Russian Federation	02
XX.	National Safeguards Training Course	20.08.2023-24.08.2023	Rooppur NPP Training Center, JSC ASE	06
XXI.	V05 (plant system and ventilation), RAW treatment Shop	04.06.2023-14.08.2023	Rooppur NPP Training Center, JSC ASE	07
XXII.	V02 (plant system and ventilation) Ventilation Shop A01 (Administrative Issues), S02 (Regulatory basis)	04.06.2023-29.08.2023	Rooppur NPP Training Center, JSC ASE	07
XXIII.	C03 (Theoretical basic of VVER type NPP) S02 (Regulatory basis), APCS & EE Services	01.08.2023-03.12.2023	Rooppur NPP Training Center, JSC ASE	03
XXIV.	Qualification Maintenance, Process Management service	01.08.2023-14.08.2023	Rooppur NPP Training Center, JSC ASE	10
XXV.	C03 (Theoretical basic of VVER type NPP) E03 (ES equipment and systems), APCS & EE Services	01.08.2023-10.12.2023	Rooppur NPP Training Center, JSC ASE	02
XXVI.	C03 (Theoretical basic of VVER type NPP) E03 (ES equipment and systems), APCS & EE Services	01.08.2023-10.12.2023	Rooppur NPP Training Center, JSC ASE	01

Sl. No.	Title (training program/workshop/ seminar/ symposium/ conference)	Date	Place	No. of participant
XVII.	TS, RS, GS (FSS Training), Process Management Services	30.08.2023-26.11.2023	Rooppur NPP Training Center, JSC ASE	10
XVIII.	PRA (Practical training course on specific topics of Rooppur NPP) , APCS & EE Services	01.08.2023-22.08.2023	Rooppur NPP Training Center, JSC ASE	04
XIX.	PRA (Practical training course on specific topics of Rooppur NPP), APCS & EE Services	23.08.2023-29.08.2023	Rooppur NPP Training Center, JSC ASE	03
XXX.	PRA (Practical training course on specific topics of Rooppur NPP), ventilation Shop	20.08.2023-24.08.2023	Rooppur NPP Training Center, JSC ASE	04
XXI.	PRA (Practical training course on specific topics of Rooppur NPP), Raw Treatment Shop	27.08.2023-31.08.2023	Rooppur NPP Training Center, JSC ASE	03
XXII.	PRA (Practical training course on specific topics of Rooppur NPP, Raw Treatment Shop	16.08.2023-22.08.2023	Rooppur NPP Training Center, JSC ASE	04
XXIII.	PRA (Practical training course on specific topics of Rooppur NPP , Raw Treatment Shop	23.08.2023-29.08.2023	Rooppur NPP Training Center, JSC ASE	03
XXIV.	DC02 (Theoretical basic course on VVER type NPP), Support System Shop	20.08.2023-04.10.2023	Rooppur NPP Training Center, BAEC	04
XXV.	DC02 (Theoretical basic course on VVER type NPP) DS02(Regulatory basis, Capital Construction	13.08.2023-08.11.2023	Rooppur NPP Training Center, BAEC	04
XXVI.	E04 (ES Equipment and system), APCS & EE Services	08.08.2023-19.09.2023	Rooppur NPP Training Center, BAEC	07
XVII.	Training For D & F category of Support System Shop (Pump operator, Jr. Technician)	18.09.2022-15.12.2022	Rooppur NPP Training Center, BAEC	06
XVIII.	Training For D & F category of Capital Construction (Sr. Engg. / Engg. / SAE)	05.02.2023-25.05.2023	Rooppur NPP Training Center, BAEC	05
XIX.	Training For D & F category of CRS	18.06.2023-12.07.2023	Rooppur NPP Training Center, BAEC	02
XL.	Training For D & F category of Decontamination Shop	18.06.2023-19.07.2023	Rooppur NPP Training Center, BAEC	04
XLI.	Training For D & F category of APCS and EE services	18.06.2023-19.07.2023	Rooppur NPP Training Center, BAEC	01

2. Seminar/Symposium/Conference/Workshop/Meeting Attended

Name of the participant	Title of the event	Organizer	Date	Place
Wakil Ahmed, Nashidul Islam, Mohammad Al Beroney	Basic course on maintenace and Repair for Rotating equipment group	MRPTD	14 -18 Nov'21	Rooppur NPP Training center
Nashidul Islam	Workshop on visual and Measurement	MRPTD	22 Sep'22 - 18 Oct'22	Rooppur NPP Training center
"Md. Moniruzzaman	Workshop on OSART Methodology	MSD	29-31 May'23	Rooppur NPP Training center
Emran Hossain "	Introductory Training on refueling machine installation	MRPTD	06 Jun'23	Rooppur NPP Training center
Wakil Ahmed, md. Abdur Rohoman	Introductory Training on M&R Documentation	MRPTD	24 Jul'23	Rooppur NPP Training center
Mohammad Al Beroney, Wakil Ahmed	Fire Safety Fundamentals at NPP	GTD	21-23 Aug'23	Rooppur NPP Training center
Sayed Nazmul Hossain	Work at height	GTD	19-20 Sep'23	Rooppur NPP Training center
Shuvra Dey	Introductory Training on refueling machine operation	MRPTD	13 Sep'23	Rooppur NPP Training center
Wakil Ahmed, Md. Abdur Rohoman	Introductory Training on Heat Exchange Equipment	MRPTD	14 Sep'23	Rooppur NPP Training center
Nashidul Islam	Workshop on Radiation safety	GTD	03 Oct'23	Rooppur NPP Training center
Md. Mahmudun Noby	Workshop on SAT	OPTD	10-11 Dec'23	Rooppur NPP Training center
Abduallah Al Faisal	Work at height	GTD	17-18 Dec'23	Rooppur NPP Training center
Shuvra Dey	Workshop on Main Electric circuit simulator	OPTD	19 Dec'23	Rooppur NPP Training center
Irfanul Haque, Md. Kazem Hossain, Prosenjit Debanath	Introductory Training on Pick and Place Simulator	MRPTD	19 Dec'23	Rooppur NPP Training center
Wakil Ahmed	Introductory Training on M&R Documentation	MRPTD	20 Dec'23	Rooppur NPP Training center
Mohammad Al Beroney	Fire Safety Fundamentals at NPP	GTD	24 Dec'23	Rooppur NPP Training center
Sayed Nazmul Hossain	Workshop on Main Electric circuit simulator	OPTD	26 Dec'23	Rooppur NPP Training center
Irfanul Haque, Md. Kazem Hossain, Prosenjit Debanath	Introductory Training on Heat Exchange Equipment	MRPTD	26 Dec'23	Rooppur NPP Training center
Nashidul Islam	Introductory Training on Thermal Mechanical Equipment and Ventilation Systems	MRPTD	27 Dec'23	Rooppur NPP Training center
Wakil Ahmed, Nashidul Islam	Introductory Training on Work at height on Dismountable polygon	GTD	01 – 02 Jan '24	Rooppur NPP Training center
Nashidul Islam	Workshop on Main Electric circuit simulator	OPTD	01 - 03 Jan'24	Rooppur NPP Training center
Sayed Nazmul Hossain	Introductory Training on Pick and Place Simulator	MRPTD	03 Jan'24	Rooppur NPP Training center

Name of the participant	Title of the event	Organizer	Date	Place
Irfanul Haque, Md. Kazem Hossain, Prosenjit Debanath	Introductory Training on M&R Documentation	MRPTD	04 Jan'24	Rooppur NPP Training center
Nashidul Islam	Fire Safety Fundamentals at NPP	GTD	09 Jan'24	Rooppur NPP Training center
Mohammad Al Beroney	Workshop on Main Electric circuit simulator	OPTD	09-11 Jan'24	Rooppur NPP Training center
Nashidul Islam	Introductory Training on Heat Exchange Equipment	MRPTD	09 Jan'24	Rooppur NPP Training center
Md. Kamruzzaman prodhan	Introductory Training on Thermal Mechanical Equipment and Ventilation Systems	MRPTD	10 Jan'24	Rooppur NPP Training center
Mohammad Al Beroney	Ultrasoninc Testing	MRPTD	11 Jan'24	Rooppur NPP Training center
Md. Kamruzzaman prodhan	Workshop on relay protection and automatics	GTD	15 Jan'24	Rooppur NPP Training center
Mohammad Al Beroney	Introductory Training on M&R Documentation	OPTD	16-18 Jan'24	Rooppur NPP Training center

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 materials having in the BAEC.
- To maintain safeguards procedures of the State Systems of Accounting for and Control of Nuclear Material (SSAC).
- 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.

Activities

1. Research and Development 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 assists 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.

2. Seminar/Symposium/Conference/Workshop/Meeting Attended

Name of the participant	Title of the event	Organizer	Date	Place
Dr. Md. Shakilur Rahman	Technical meeting (protocol development for system accreditation) and workshop on operation and maintenance of TLD system	RadPro International, Germany (ADP Project)	8-12 August 2022	Hasenjagd, Germany

Name of the participant	Title of the event	Organizer	Date	Place
	IAEA-Fukui workshop on safety culture self-assessment for regulatory bodies	IAEA-Japan	27 February to 03 March 2023	Fukui, Japan
	Technical meeting on topical issues in the development of nuclear power infrastructure	IAEA	14 - 17 March 2023	Vienna, Austria
Dr. Abid Imtiaz	Technical Meeting of Analysis Support for Enhanced Nuclear Energy Sustainability Pilot Study on Sustainable Deployment Scenarios for Small Modular Reactors	IAEA	9-12 August, 2022	Vienna, Austria
Dr. Abid Imtiaz	FY2022 Hybrid Workshop on Nuclear Security and Safeguards	FNCA	10-12 January, 2023	Bangkok, Thailand

3. Collaboration work/MoU

- NSSS Division has been working as the national focal point for Bangladesh's Integrated Nuclear Security Support Plan (INSSP). According the action plan of INSSP, Various national training programs/events on bring conducted. During the reporting period "Bangladesh Training Course Nuclear Material Accounting and Control for Nuclear Security Purposes at Facilities; with arranges in Russia on 15-17 November 2022."
- This Division has been continuing research on 'Factors that Influence Culture for Safety, Organizational Culture and Human Performance at Nuclear and Other Facilities in Bangladesh' under the IAEA Coordinated Research Project (CRP) 'I22004' entitled 'Organizational Culture Basis for Successful Performance in Nuclear Power Plants'. A conceptual model of organizational and human factors was developed as they interact with the national cultural dimensions of Bangladesh based upon the work of Hofstede. In order to capture these factors and collect data, survey has been going on to validate the model against the IAEA framework of safety culture.
- This Division has been continuing participation in the 'Nuclear Security and Safeguards Project' under the cooperation activities of FNCA. Bangladesh participated in the 11th Hibrid Workshop on this Project held during 10-12 January, 2023.
- Supervision of security enhancement activities at the nuclear and radiological facilities of AERE and in parallel to the governmental and private hospitals of the country having radiotherapy machines consisting of radioactive sources and concealed radioactive materials therein under the Basic Ordering Contract (BOC) No. 11968-AD8, Rev. 1 between BAEC and Battelle Memorial Institute (BMI) of U.S. Department of Energy.

VIII. PLANNING AND DEVELOPMENT DIVISION (PDD), BAEC HQ

Introduction

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.

Programs

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 2022-2023 for implementation of ongoing projects of BAEC was Tk. 1160484.00 Lakh. Out of this granted allocation, Tk. 10587957.85 Lakh had been spent up to 30 June 2023 making an implementation rate of 91.16%. The entire picture on the advancement of all the development projects currently under implementation is depicted in the following table.

Activities

1. On-Going Projects

(Taka in lakh)

1.	Construction of Rooppur Nuclear Power Plant, Apr. 2016 - Dec. 2025	11309291.27 1016000.00	5567916.77 948544.00	1113915.00 128018.00	1015110.74 128018.00	91.13% 99.93%	Ongoing
2.	Establishment of Institute of Nuclear Medicine and Allied Sciences (INMAS) at 8 Medical College Hospital Campuses in the country, Jul. 2017 - Jun. 2023	60430.00 23785.00	36640.92 12000.00	25352.00 11785.00	22857.75 11785.00	90.16% 100%	Project completed PCR submission is in process
3.	Establishment of Calibration and Quality Control Facilities for Radiotherapy, Diagnostic Radiology and Neutron, Jul. 2017 - Jun. 2023	4857.11 2991.00	3786.50 2324.00	1008.00 640.00	1008.00 640.00	100% 100%	Project completed PCR submission is in process
4.	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, Jul. 2018 - Jun. 2023	70300.00 33923.00	15242.25 365.00	10909.00 7935.83	10909.00 7935.83	100% 100%	Project completed PCR submission is in process
05.	Improvement and modernization of the laboratory Facilities of Institute of Electronics, July 2018 - Dec. 2022	3553.70 2102.50	2898.98 2052.83	470.00 193.00	454.85 193.00	96.77% 96.77%	Ongoing
06.	Balancing, Modernization, Refurbishment and Extension (BMRE) of Safety Systems of the 3 MW TRIGA Mark-II Research Reactor Facility at AERE, Savar, Dhaka, July 2018 - June 2024	8543.58 4180.14	5620.34 3820.11	1829.00 255.00	1772.88 255.00	96.93% 99.99%	Ongoing
07.	Strengthening of existing gamma source of Bangladesh Atomic Energy Commission January 2021 – June 2023	5232.00 4391.00	121.95 64.00	2086.00 1957.00	1753.10 1664.10	84.04% 98.87%	Ongoing
08.	Modernization and Strengthening of Services and Research Facilities of the Institute of Tissue Banking and Biomaterial Research July 2021 – June 2025	17380.14 6728.65	525.91 0	2553.00 0	2135.28 0	83.63% 100%	Ongoing

09.	Modernization of Laboratories and Enhancement of Service Capacity of 3 Divisions (Chemistry Division, Health Physics Division, Experimental Physics Division) of Atomic Energy Centre, Dhaka July 2021 – June 2024	4498.00 3112.00	204.78 0	1342.00 900.00	1101.10 900.00	82.04% 96.52%	Ongoing
10.	“Enhance Capacity of Institute of Nuclear Medicine and allied Sciences (INMAS) INMAS Mitford, Cumilla, Faridpur, Barishal and Bogura”	23076.00 13695.00	0.00 0.00	1020.00 630.00	855.15 630.00	83.83% 100%	
	Total	11507161.80 1110908.29	5632958.00	1160484.00	1057957.85	91.16%	

2. Advancement of the Development Project (Approved & unapproved) of BAEC under ADP

Sl. No	Name of the project, approval status and implementation period	Approval status	Estimated cost Total	Proposed ADP for the year of 2022-2023	Remarks
Proposed new project					
1.	Establishment of Institute of Nanotechnology July 2023 - June 2028	Unapproved	38912.00 18204.00	0	Awaiting approval from the Planning Commission
2.	Establishment of Genome Sequencing Facilities at NINMAS, Dhaka and INMAS, Chittagong. July 2023 - June 2026	Unapproved	4691.00 3298.80	0	Awaiting approval from the Planning Commission.
3.	Rooppur Nuclear Power Plant Community Hospital and Emergency First Aid Center Establishment Project.	Unapproved	113374.00	0	Awaiting approval from the Planning Commission.
4.	Establishment of National Nuclear and Radiological Emergency Management Centre (NNREMC)	Unapproved	34967.00	0	Awaiting approval from the Planning Commission

3. Manpower Development

Sl. No.	Title (training/program/workshop/seminar/symposium/conference)	Date	Place	No. of participants
1	Day long training on e-governance and innovation planning	18/11/2022	Alpha Hall	18
2	A Day-long Workshop on as part of service facilitation activities “Integrated Digital Service Delivery Platform (IDSDP)”	29/03/2023	Alpha Hall	18
3	A Day-long Workshop on ADP, RADP এবং IBASS ⁺⁺⁺	28/05/2023	Alpha Hall	10

4. Seminar/Symposium/Conference/Workshop/Meeting Attended

SL No.	Name of the participant	Title of the event	Organiser	Date	Place
1	Dr. Syed Mohammad Hossain	The 11th Meeting of the Working Group on RCA Mid-Term Strategy Coordination	IAEA	3-5 August 2022	Virtual Meeting

SL No.	Name of the participant	Title of the event	Organiser	Date	Place
2	Dr. Syed Mohammad Hossain	The 12th Meeting of The Working Group on RCA Mid-Term Strategy Coordination	IAEA	20-24 March 2023	Virtual Meeting
3	Dr. Syed Mohammad Hossain	The 13th Meeting of The Working Group on RCA Mid-Term Strategy Coordination	IAEA	14-18 August 2023	Vienna, Austria
4	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

5. 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 2022-23.

Date	place	Number of projects discussed
06-10-2022	Alpha Conference Hall	8
26-01-2023	Same as Above	9
25-05-2023	Same as Above	9

6. Collaboration Work

Type Of Collaboration	Collaborating Agency/ Institute	Date
MoU	Dhaka Water Supply and Sewerage Authority (DWASA)	18.02.2023

7. Other Activities

Dr. Syed Mohammad Hossain, Director P&D was actively engaged in the following activities [1-24]

1. Vice Chair of “IAEA-RCA Mid-term Strategy Coordination Group”.
2. APA Team Leader of BAEC.
3. Convener and focal point of BAEC’s “E-Governance and Innovation” team.
4. Convener of the Memorandum of Understanding (MoU) Standing Committee to examine the Draft MoU before signing with various organizations in home and abroad.
5. Convenor of the Committee for suggesting of notional seniority to the officers of the Commission.
6. 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.
7. 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”.
8. Convenor of the Technical Evaluation Committee for the current ADP project “Enhance Capacity of Institute of Nuclear Medicine and Allied Sciences (INMAS) at Mitford, Cumilla, Faridpur, Barishal and Bogura”.
9. Convenor of the Technical Evaluation Committee for the current ADP project “Strengthening of existing gamma source of Bangladesh Atomic Energy Commission”.

10. Convenor of the Technical Evaluation Committee for the current 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”.
11. Convener of the committee formed to provide recommendations for employment in BAEC/NPCBL for the students who were sent to The Moscow Engineering Physics Institute of the National Research Nuclear University (MEPhI) in the academic year 2014-2021 of the Russian Federation and completed higher education.
12. As a part time teacher conducting a theoretical course in MS level in the Dept. of Nuclear Engineering, University of Dhaka.
13. Member of the Editorial Board of the BAEC’s Journal of Nuclear Science and Applications.
14. Member of Commission's Promotion Bio-Data Evaluation Committee-II.
15. Member of the Committee for suggesting of notional seniority to scientists/equivalent officers of the Commission.
16. Member of the reconstituted Standing Committee on Works/Construction/Procurement under the Revenue budget and Projects of the Commission.
17. Member of Technical Committee on Draft Contract between Bangladesh Atomic Energy Commission and Joint Stock Company (The Russian Federation) for execution of works on construction of household and drinking water intake facility at Rooppur NPP construction site.
18. Member of the committee constituted for the examination of the DPP of the proposed project on the evaluation of the sites initially identified for the construction of nuclear power plants in the southern region of Bangladesh.
19. Member of Senior Selection Committee regarding recruitment of Gas Transmission Company Limited (GTCL).
20. Member of the Recruitment and Promotion Committee formed to provide recruitment and promotion to Grade-12 to Grade-5 posts of National Science and Technology Museum.
21. Member of Syllabus Formulation Committee of Department of Nuclear Engineering, Dhaka University.
22. Member of Syllabus Formulation Committee of Department of Physics, Comilla University.
23. Implementation of the ADP project titled “Capacity Building of Institute of Nuclear Medicine and Allied Sciences (INMAS) Dhaka, Chittagong, Rajshahi, Khulna, Sylhet, Dinajpur and Rangpur”; Project Director: Dr. Md Jahangir Alam, CSO, Planning and Development Department.
24. Implementation of the ADP project titled “Establishment of Institute of Nuclear Medicine and Allied Sciences (INMAS) in 8 Medical College Hospital Campuses of the country” is ongoing; Deputy Project Director: ASM Habibullah Khan, CSO, Department of Planning and Development.

IX. QUALITY MANAGEMENT DIVISION (QMD), BAEC HQ

Introduction

In the fiscal year of 2022-2023 Quality Management Division (QMD) kept up its active involvement in the implementation activities of RNPP Construction Project. Some other important tasks that QMD scientists performed include “help finalize and submit the draft of ‘BAEC Service Regulations, 2023’ to the Ministry of Science and Technology”, “submitting reports on SDGs”, “updating BAEC organization structure”, helping in carrying out tasks and preparing working documents and reports under activities of E-Governance & Innovation Team, Updating Zilla Quota for BAEC employees under 14-20 Grades, preparing combined seniority list for newly recruited scientists, sorting out applications and making recommendations for providing financial grants to science promoting/serving organizations and science related professional bodies/establishments, carrying out other assignments like preparing quality related presentations, reviewing draft of IAEA document etc. and performing 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))]. In this fiscal year several Incoming Control Inspections at the site were carried out that included associated documentations review as well.
- Performed duties as Member of the Joint Training Advisory Commission (JTAC) for conducting manpower training programme/developing/preparing documents for NPP Training Centre/ensuring 'quality implementation' of manpower training for Rooppur NPP operating personnel under Appendix 14 of General Contract.
- Performed duties as Technical Committee Member for the Evaluation of Construction and Erection Works of Rooppur NPP.
- Performed duties as Member of the 'Entry Level Test conduct committee' to sort out candidates for the training of Rooppur NPP Personnel in Russian Federation and NPP Training Centre, Rooppur.
- Delivered duties (to discuss outstanding issues/finalize relevant issues) as a member regarding the Installation and Acceptance Tests activities of Full Scope Simulator (LTME 29) and Analytical Simulator (LTME 30) of Rooppur NPP Training Center.
- Participated as a Technical Committee Member during Readiness Inspection and Temporary Handover of Rooppur NPP Training Center.
- Actively involved in reviewing RNPP construction/commissioning/operational/safety/ licensing related documents.
- Participated in reviewing Class D License documents related to Nuclear Fresh Fuel transport.
- Participated in Quality Inspection of Laboratories and Test Facilities used during the construction of Rooppur NPP which also included inspection of overall activities of the project.
- Performed duties as Member of the committee formed to conduct knowledge assessment (of the trainees who have returned after the completion of their training in Russian Federation)/discuss Job Regulation and Job Description as per Appendix-14 under General Contract.
- Actively involved in reviewing training documents and Group Training Programmes (GTP) as per Appendix-14 under General Contract.
- Participated in several Milestone Achievement associated meetings.
- Participated in several Equipment Specification related meetings.
- Performed duties as a member of the Committee formed to prepare "Self-Assessment Report" with a view to arranging IAEA-pre-OSART mission.
- Participated in Training Milestone Certificate related meetings.

2. Performing duties as other different Committee Member

- Performed duties as a Member of the Editorial Board for the BAEC Journal of Nuclear Science & Applications.
- Performed duties as Member of Departmental Promotion Committee-3 of BAEC.
- Performed duties as Member of the Review Committee for the new Annual Development Project before submitting to the Ministry.
- Performed duties as Member of the Evaluation Committee 1.
- Participated in evaluating Best Research Paper from BAEC scientists working in AECD.

3. Updating Zilla Quota for BAEC employees under 14-20 Grades

Actively involved in updating Zilla Quota for BAEC employees under 14-20 Grades.

4. Updating "BAEC Service Regulations, 2023"

Actively engaged in finalizing the draft of "BAEC Service Regulations, 2023" in light of BAEC Service Regulations, 1985 and Bangladesh Atomic Energy Commission Act, 2017. Took necessary measures to submit the draft to the Ministry of Science and Technology.

5. Sorting out applications for financial grants

Actively engaged in sorting out applications and making recommendations for providing financial grants to science promoting/serving organizations and science related professional bodies/establishments,

6. Preparing and Submitting several reports on SDGs

QMD Scientist prepared and submitted the following SDGs related reports-

- Sustainable Development Goals (SDGs) Target Implementation Progress: Up to January 2023.
 - Achievements from completed projects under BAEC up to January 2023 regarding SDGs.
 - Briefing on activities under BAEC in relation to SDGs for Budget Speech (2023-2024);
- 7. 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.

8. Designing Posters

To create awareness on Quality Culture, Safety, Policy etc. some posters were designed.

9. Preparing Combined Seniority List under recruitment

QMD prepared 'Combined Seniority List' of newly recruited scientists as per the procedure BAEC/SOP-009 (rev.3).

10. Updating BAEC Organization Structure

QMD scientist actively engaged in updating BAEC Organization Structure.

11. Carrying out other assignments

Actively engaged in carrying out some other assignments like preparing quality related presentations, reviewing draft of IAEA document etc.

12. Seminar/Symposium/Conference/Workshop/Meeting Attended

Name of the participant	Title of the event	Organizer	Date	Place
Dr. Md. Quamrul Huda, CSO & Director, QMD	Joint Training Advisory Committee (JTAC) meeting and Hold point inspection	BAEC	27 June-03 July, 2022	Moscow, Russian Federation
	Joint Training Advisory Committee (JTAC) meeting and Hold point inspection	BAEC	7-16, November, 2022	Moscow, Russian Federation
	Joint Training Advisory Committee (JTAC) meeting and Hold point inspection	BAEC	22 May-02 June, 2023	Russian Federation

13. Other Activities

- QMD personnel delivered duties as the members of some other committees.

X. SCIENTIFIC INFORMATION DIVISION (SID), BAEC HQ

Introduction

Scientific Information Division plays the key role to collect select, process and provide information to a wide range of stakeholders concerned with the R & D activities of BAEC. In addition, SID acts as an liaison between BAEC and the government on one hand and public, press etc. on the other hand.

Activities

- Compilation, editing and publication of scientific journals, periodical reports, annual reports, popular scientific articles, brochure, proceedings, souvenir, leaflet, etc. related to R & D works of BAEC
- Collection, selection, processing for storage and dissemination of information in the field of scientific research and development of all branches of sciences
- Maintaining liaison with the News media, TV, Radio, etc. to disseminate news of scientific programmes, symposia, conference, seminar, workshop, training etc. under R & D and service activities of BAEC
- Updating information/documents in the website
- Selection, acquisition and distribution of Books, Journals, Calendar, Magazines, Annual report, Scientific News Letter and other scientific documents
- Processing nomination of BAEC scientists to attend various National Seminar, Symposium, Conference, Workshop etc.
- Processing nomination of BAEC Scientists for award at home and abroad
- Preparing reports and providing information for the National Assembly/Ministry of Science and Technology and other relevant government authorities relating to BAEC activities
- Publishing tender/notification/press release of BAEC in the daily newspapers
- Taking and displaying of photographs in different occasions of BAEC and documentation of printed photographs for further use etc.
- Compilation, Editing and Publication of diary/telephone index/guide books, booklets, yearly calendar, etc.
- Collection and upgrade the abstract of published scientific papers in BAEC website www.baec.gov.bd

Remarkable Achievement

Description of work	Quantity	Remarks
Publishing BAEC Annual Report 2021-2022	300	Published, distributed and uploaded to the BAEC website www.baec.gov.bd
Arranging/Attending science fair/digital fair	2	Successfully completed
Publishing BAEC Diary 2023	1300	Published and distributed
Publishing telephone directory 2023 in Bangla	670	Published and distributed
Publishing Tender/Advertisement etc. to the newspaper	50	Published in the 110 daily newspapers
Newspaper clipping	28	Successfully completed
Press release on training, workshop conducted by BAEC and other BAEC programmes	7	Published in the daily newspapers
Photographic service (processed, printed and supplied)	4500	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	25	Nomination letters were distributed to the relevant participants
Provide National Parliamentary questions and answers	2	Successfully completed
Provide Parliamentary Committee Report	3	Successfully completed

Description of work	Quantity	Remarks
Provide BAEC information for Preparation of Ministry Annual Report	2	Successfully completed
Preparation of annual performance agreement (APA) 2023-2024 between BAEC and MOST	1	Successfully completed
Preparation of annual performance agreement (APA) 2023-2024 between BAEC and subordinate organizations	32	Successfully completed
Preparing APA reports of BAEC	17	Successfully completed
Providing input for different bilateral contract/MoU/ international conference/meeting	2	Successfully completed
Preparing and providing opinions on the issues, acts, laws, etc.	20	Successfully completed
Preparing and providing monthly report to MOST	12	Successfully completed
Preparing and providing Election manifesto report to MOST	12	Successfully completed
Preparing and providing National Integrity Strategy (NIS) Report	3	Successfully completed
APA Report uploaded to APAMS of Cabinet Division	4	Successfully completed
Printing BAEC Annual Calendar 2023	2600	Successfully completed
Uploaded different programmes in BAEC facebook	15	Successfully uploaded
Arranged Training Programme	4	Successfully uploaded

XI. HUMAN RESOURCES DIVISION (HRD), BAEC HQ

Introduction

Human resource department is usually responsible for effectively managing human resources or employees of an organization to achieve better performance. The department is also responsible for overseeing the policies and the relationship of the organization with its employees. This human resource management approach remains as an integral part of an organization's core strategy and vision. It pursues to optimize the development and the use of human resources for achieving the organizational goals. The strategic and philosophical contexts of human resource development and management make it more purposeful, relevant and effective compared to the traditional establishment approach. With these in view, the Human Resources Division (HRD) of BAEC is launched and working directly under the Chairman for the learning & development of its employees as well as managing its human resources.

Activities

1. Human Resource Development

The HRD vision takes necessary action in nominating and developing the organization's work force through employee training and career development mostly in national level which ultimately improves organizational effectiveness and performance. Within organizational level, the division assists and encourages all institutes in arranging specialized training.

2. Human Resource Management

Human resource management is all about optimizing organization's performance through better management of its employees usually using a Human Resources Information System. Nevertheless, the HRD while needed takes necessary steps and assists the authority by giving critical opinion on employee related matters including enquiring charges against any employee for proper management.

3. Manpower Development (through National Training Program)

Human resource development programs of BAEC are for all of its employees. The 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, Twenty-Three (23) participants from different institutes of BAEC were nominated for various training.

4. Seminar/Symposium/Conference/Workshop/Meeting Attended

Name of the participant	Title of the event	Organizer	Date	Place
Dr. Md. Shakil Ahmed	FY2022 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)	২4-26 January 2023	Dhaka, Bangladesh

5. Collaboration work

According to the 44th Regional Meeting of National RCA Representatives, the RCA Scholarship Committee Meeting was requested to take an in-depth study of the RCA Scholarship Programme and submit a report on the Feasibility Study (FS) of the programme to the 51st GCM for consideration and decision. Dr. Md. Shakil Ahmed, Director, HRD was assigned by BAEC to complete a survey report. This survey was conducted to evaluate suitable academic institutes/ universities in the region to be selected as the training institutes for the Scholarship Programme and to identify priority areas of human resources development including nuclear science and technology and related nuclear applications.

6. Others

- a) Director, HRD has been working 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), Government of the People's Republic of Bangladesh. The government is in the process of making all public services to digital so that they are available at the doorsteps of any citizen in the form of electronics service. 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.

- b) Director, HRD is also assigned as a Member for various internal committees including Divisional Evaluation Committee as well as a few external committees.
- c) Sr. Administrative Officer, HRD is 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.
- d) Sr. Administrative Officer, HRD has 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 (SIU), AERE

Objectives

The main responsibilities of the Scientific Information Unit (SIU) are to furnish documentation of the scientific achievements attained in different Institutes/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, vol. 27: The major documentation activity within the reporting period involves publication of the AERE Technical Report, vol.27 by the SIU. The report covers the activities and achievements of AERE in 2021. 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 05 books of different titles to be used by the scientists/researchers of AERE.
- Co-operation in Seminars/Symposium/Workshop held in AERE: The Unit extended technical co-operation (photography) in documenting seminars/symposium/workshops held in AERE.
- Attendance to Delegates/Visitors: During the period under report the Unit had to host as many as 35 groups of delegates and visitors (comprising 1430 visitors) from both home and abroad to AERE.
- 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.
- Database Service: The Unit provides on-line database & e-catalogue searching facilities.
- Fax service: Fax services are available at the Unit with the modern fax machine for receiving and sending official documents to and from AERE.
- Current Awareness Service (CAS) and Selective Dissemination Service (SDS): To inform the scientists and researchers at AER books/journals etc. are listed on the basis of recent collections.
- News Clipping Compilation and Perseveration: 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.
- 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

Introduction

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 country's first Nuclear Power Plant (NPP) of Bangladesh is going to be established 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. Followings are the activities performed in the reported period.

Activities**1. Training Programs Conducted for the Human Resource Development**

Title of the event	Date	Place	No. of participants
Training course on 'Official Etiquette and General Behavior-IX'	29-31 Aug. 2022	TI, AERE	30
Training Course on 'PPR-2008 and public Procurement Management.	10-20 Oct. 2022	TI, AERE	40
11 th FTC on Nuclear and Radiological Emergency Preparedness	04-15 Dec. 2022	TI, AERE	18
10 th FTC on Environmental Radioactivity Monitoring	15-19 Jan. 2023	TI, AERE	21
10 th FTC on Reactor Engineering	12 Feb-2 Mar. 2023	TI, AERE	18
A Brief Orientation Course on Nuclear Sciences and Technologies in Modern Research, (for the young Scientists of BINA)	21-24 May 2023	TI, AERE	30
Total			154

2. Seminar/Symposium/Conference/Workshop/Meeting Attended

Name of the participant	Title of the event	Organizer	Date	Place
1. Dr. Ananda Kumar Das	i) Meeting of Joint Training Advisory Commission (JTAC) with Russian Counterparts	HR Division of RNPP and JSC Atomstroy-export, Russia	27 June -03 July 2022	Moscow, Russia
	ii) Learning Session on APA	SID, BAEC	23 March 2023	BAEC, Head Quarters, Dhaka
	iii) BAEC- JAEA Steering Committee Meeting	IAD BAEC	24-26 Jan. 2023	-Do-
	iv) National Integrity and Feedback Related Meeting	SID, BAEC	13 April 2023	-Do-
	v) (JTAC) with Russian Counterparts	RNPP	17 May 2023	RNPP Bhaban, Dhaka
2. Mahmudul Hossain	Workshop on 4 th Industrial Revolution	BAEC	23 Jan 2023	BAEC, Head Quarters, Dhaka
3. Md. Mofakkharul Islam Chowdhury	Seminar on Integrated Digital Service Delivery Platform	BAEC	29 March 2023	-Do-

3. Lecture Delivered

Dr. Ananda Kumar Das has delivered following Lectures in different courses held in TI within 2022-23 fiscal years:

i) Basics of Radiation Physics, **ii)** Nuclear and Radiological Emergency Preparedness **iii)** Degradation or Damage of Materials due to Radiation Exposure **iv)** Materials Properties of a Nuclear Power Reactor, **v)** Disaster Management (Bangladesh Perspective) **vi)** National Integrity Strategy of Bangladesh **vii)** Good Practices etc.

4. Revenue Income

Sl. No.	Type (name) of the service	Income (Tk.)
1.	Dormitory Rent	1,82,000.00
2.	Course Fee	6,000.00
Total		1,88,000.00

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	8848.00	---	8848.00
3631102	Allowance Support	7519.75	---	7519.75
3631103	Goods and Service Support (With Service Charge)	2861.40	8611.48	11472.88
3631104	Pension and Retirement Support	4774.25	---	4774.25
3631108	Research Grant	300.00	78.00	378.00
3631109	Primary Healthcare Services Grant	4.00	2.00	6.00
3631199	Others Grant	135.00	---	135.00
Sub- total		24442.40	8691.48	33133.88
3632102	Machineries Grant	368.00	259.00	627.00
3632104	Building & Structure Construction Grant	25.00	---	25.00
3632105	Information and Communication Technology Grant	12.50	15.50	28.00
3632106	Others Capital Grant	10.00	8.00	18.00
Sub- total		415.50	282.50	698.00
Total		24857.90	8973.98	33831.88

2. Center/ Institute Wise Revenue Budget Allocation

(Taka in lac)

Name of the center/institute	Revenue budget allocation
Bangladesh Atomic Energy Commission, HQ	3310.00
Works Branch	705.00
BAERA, Dhaka	385.00
Atomic Energy Centre, Dhaka	2283.00
Atomic Energy Research Establishment, Saver	7506.00
National Institute Of Nuclear Medicine & Allied Sciences, Shahbag, Dhaka	1203.00
Institute Of Nuclear Medicine & Allied Sciences, Chattogram	343.00
Institute Of Nuclear Medicine & Allied Sciences, Rajshahi	347.00
Institute Of Nuclear Medicine & Allied Sciences, Dinajpur	228.00
Institute Of Nuclear Medicine & Allied Sciences, Sylhet	214.00
Institute Of Nuclear Medicine & Allied Sciences, Dhaka	598.00
Institute Of Nuclear Medicine & Allied Sciences, Barishal	252.00
Institute Of Nuclear Medicine & Allied Sciences, Khulna	305.00
Institute Of Nuclear Medicine & Allied Sciences, Rangpur	372.00
Institute Of Nuclear Medicine & Allied Sciences, Mymensingh	492.00
Institute Of Nuclear Medicine & Allied Sciences, Bogura	325.00
Institute Of Nuclear Medicine & Allied Sciences, Cumilla	248.00
Institute Of Nuclear Medicine & Allied Sciences, Faridpur	267.00

Name of the center/institute	Revenue budget allocation
Institute Of Nuclear Medicine & Allied Sciences, Mitford	340.00
Institute Of Nuclear Medicine & Allied Sciences, Cox's Bazar	138.00
Atomic Energy Centre, Chattogram	284.00
Beach Sand Minerals Exploitation Centre, Cox's Bazar	148.00
Rooppur Nuclear Power Plant, Pabna	130.00
Radioactivity Testing And Monitoring Laboratory, Mongla, Bagerhat	100.00
Bangladesh Atomic Energy Commission (Foreign Exchange Branch)	3110.34
Bangladesh Atomic Energy Commission (Pension Branch)	4774.25
Service Charge Branch, BAEC, Dhaka	3447.54
Reserve for return to Gov. fund	1976.75
Total=	33831.88

XV. SUPERVISION OF THESIS

ATOMIC ENERGY CENTRE (AEC), DHAKA

Chemistry Division, AECD

1. Joint supervisor: Dr. Shamshad. B. Quraishi, "A study of determination of Heavy metal of water and sediment of aquaculture (soft shell crab, live crab, shrimp and prawn) farm at Shyamnagar, Satkhira district", M.Sc. Thesis (Oinisha Islam), Department of Zoology, Jagannath University (JnU), 2022
2. Joint supervisor: Dr. ShamshadB. Quraishi, "Investigation of Sources and Distribution of Heavy Metals in Water and Plant leaves from the Kholpetua and Chuna River in Mangrove Forest, Satkhira, Bangladesh" M.Sc. Thesis (Munia Akter), Department of Zoology, Jagannath University (JnU), 2022
3. Joint supervisor: Dr. ShamshadB. Quraishi, "Evaluation of the metallic contamination of sediments of the Passur river of the Sundarbans mangrove forest", MS Thesis (Sabrina Islam Labonno), Environmental Science Discipline, Khulna University, 2022
4. Joint Supervision: Dr. ShamshadB. Quraishi, "Assessment of the vulnerability of mangrove ecosystem of the Sundarbans mangrove forest to metallic contamination", MS Thesis (Labonno Rana), Environmental Science Discipline, Khulna University, 2022
5. Joint supervisor: Dr. ShamshadB. Quraishi, "Estimation of heavy metals in the fish from the Passur river of the Sundarbans mangrove forest", MS Thesis (Sayed Tariq Uzzaman), Environmental Science Discipline, Khulna University, 2022
6. Joint supervisor: Dr. ShamshadB. Quraishi, "Estimation of heavy metals in the river water from the Passur river of the Sundarbans mangrove forest", MS Thesis (Marufa Jahan), Environmental Science Discipline, Khulna University, 2022
7. Joint supervisor: Dr. ShamshadB. Quraishi, "Effects of Modification of redox Potential and Plastic char on the Growth of Red Amaranth and Microbial Community in Soil & Effect of Moisture Content, Redox Potential and Plastic Char on the Growth of Plants and the transfer of Cadmium Soil to plant", MS Thesis (Tasrina Sarker), Department of Environmental Science and Resource Management, Mawlana Bhashani Science and Technology University (MBSTU), 2022
8. Joint Supervision: Dr. ShamshadB. Quraishi, "Effects of Modification of redox Potential and Plastic char on the Growth of Red Amaranth and Microbial Community in Soil & Effect of Moisture Content, Redox Potential and Plastic Char on the Growth of Plants and the transfer of Cadmium Soil to plant", MS Thesis (Tasrina Sarker), Department of Environmental Science and Resource Management, Mawlana Bhashani Science and Technology University (MBSTU), 2022
9. Joint supervisor: Dr. Yeasmin Nahar Jolly, "Spatial Distribution of Fluorescent Dissolved Organic Matter (FDOM) and Heavy Metals from Landfill Leachate to the Surrounding Water Bodies."M.S.

- Thesis (Lamisa Tahseen Sheboti), Department of Environmental Sciences, Jahangirnagar University, January, 2023.
10. Joint Supervision: Dr. Yeasmin Nahar Jolly, “Ascertaining the Carbon Dioxide Flux and the Source of Dissolved Organic Matter in the Carbon Dynamics OfKaptai Lake.” M.S. Thesis (RhidiBarma), Department of Environmental Sciences, Jahangirnagar University, January, 2023.
 11. Joint supervisor: Dr. Yeasmin Nahar Jolly, “Heavy Metal Concentrations in Fish Feeds and Fish in the Noakhali Region of Bangladesh.” M.Sc. Thesis (Ashik Hossen), Department of Fisheries and Marine science, Noakhali Science and Technology University, January, 2023.
 12. Joint supervisor: Dr. Yeasmin Nahar Jolly, “Heavy Metal Accumulation and Phytoremediation potentiality of some planted mangrove species from Chittagong Coast, Bangladesh.” M.Sc. Thesis (Sima Rani Karmakar), Department of Fisheries and Marine science Noakhali Science and Technology University, 2022.
 13. Joint Supervision: Dr. YeasminNaharJolly, “Bioaccumulation of Trace Metals in Riverine captured fish and river bed sediments of Karatoa River near industrial area in BoguraSadarUpazila and Human Health Risk Assessment.” M.Sc. Thesis (A.T.M.Ishrafil), Department of Applied Chemistry and Chemical Engineering, University of Dhaka, August, 2022.
 14. Joint supervisor: Dr. Yeasmin Nahar Jolly, “Heavy Metal Accumulation in Tilapia Fish through Consumption of Contaminated Plant Biomass from Phytoremediation.” B.Sc. Thesis (Farhana Zaman Rinvi), Department of Environmental Sciences, Bangladesh University of Professionals, January, 2023.
 15. Co-supervisor: Dr. B. A. Begum, “Analyze the Presence of Heavy Metal Concentration in Road Dust of Selective Parks in Dhaka South and North City Corporation”, B.Sc. thesis (Md Nasir AhmmedPatoary), Department of Environmental Science, Stamford University, Dhaka, 2023.
 16. Co-supervisor: Dr. B. A. Begum, “Analyze the Comparison of Heavy Metals Ramna Park and ChandrimaUdyan in Dhaka City, Bangladesh”, B.Sc. thesis (Nur Mohammad), Department of Environmental Science, Stamford University, Dhaka, 2023.
 17. Co-supervisor: Dr. B. A. Begum, “Identify the Concentration of Heavy Metal in Road Dust of Suhrawardy Udyan, Dhaka, South City Corporation”, B.Sc. thesis (Sumnun Ahmed Shafin), Department of Applied Chemistry and Chemical Technology, Noakhali Science and Technology University, 2022.
 18. Co-supervisor: Dr. B. A. Begum, “Seasonal variation of potential trace and toxic elements in airborne particulate matters (PM_{2.5}) in Dhaka City and their impact on human health”, M.Sc. thesis (Subrata Chowdhury), Department of Applied Chemistry and Chemical Technology, Noakhali Science and Technology University, 2022.
 19. Co-supervisor: Dr. B. A. Begum, “Heavy Metals Source Apportionment and Toxicity Status in Surface Water and Sediment of Turag River and Tongi Canal, Bangladesh”, M.Sc. thesis (PurbitaSahaKotha), Department of Environmental Science, Shahjalal University of Science and Technology, 2022.
 20. Co-supervisor: Dr. B. A. Begum, “Wintertime Exposure of Indoor Particulate Matter and Health Risk Assessment of PM_{2.5} on the Residents in Dhaka, Bangladesh”, M.S. Thesis (SamihaNahian), Department of Chemistry, University of Dhaka, 2022.
 21. Co-supervisor: Dr. B. A. Begum, “Source identification of toxic metals in fine particulate matter (PM_{2.5}) and their impact on human risk in Dhaka, Bangladesh”, M.Sc. thesis (ShuvodipDahar), Department of Applied Chemistry and Chemical Technology, Noakhali Science and Technology University, 2022.
 22. Co-supervisor: Dr. M. S. Rahman, “Preparation, Characterization and Thermodynamic Studies of Bio-adsorbent of Graphene Oxide/Chitosan/ Carboxymethyl Cellulose for the Removal of Potentially Toxic Metals”, M.Sc. thesis (Md. Rakibul Islam), Department of Applied Chemistry and Chemical Technology, Islamic University, Kushtia, 2023.
 23. Co-supervisor: Dr. M. S. Rahman, “Development of Chitosan/Chitosan Grafted Microcrystalline Cellulose Composite Adsorbents for the Removal of Heavy Metal Ions from Aqueous Solution”, M.Sc. thesis (Md. Hafizul Islam), Department of Applied Chemistry and Chemical Technology, Islamic University, 2023.

24. Co-supervisor: Dr. M. S. Rahman, “Assessment of physicochemical water quality parameters, pollution status and potential health risk of tap water for the people of Dhaka South City Corporation, Bangladesh”, M.Sc. thesis (Sharmin Akhter Dina), Department of Chemistry, Jagannath University, 2022.
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32. Joint supervisor: Dr. Tasrina Rabia Choudhury, “Assessment of water quality parameters in five major rivers in Dhaka region of Bangladesh”, Ph.D. Thesis (Sharmin Sultana), Department of Chemistry, University of Dhaka (DU), 2022
33. Joint supervisor: Dr. Tasrina Rabia Choudhury, “Synthesis of nano adsorbents for heavy metal remediation”, MS Thesis (Saima Alam), Department of Chemistry, University of Dhaka (DU), 2022
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39. Joint supervisor: Dr. Shirin Akter, “Evaluation of Pollutants In the sediments and fish sample of Karnaphuli River and their health risk assessment.” B.Sc. Thesis (Md. Sazzadul Islam), Department of Nuclear Engineering, University of Dhaka, April, 2023.
40. Joint supervisor: Susmita Hossain, “Heavy metal Concentration and Ecological Risk Assessment in Sediments Along Kuakata Coastline of Bangladesh”, B.Sc. Thesis (Abdullah Al Mahmood), Department of Oceanography and Hydrography, Bangabandhu Sheikh Mujibur Rahman Maritime University, Dhaka.
41. Joint supervisor: Susmita Hossain, “Elemental Analysis of Water, Soil, and Vegetables Adjacent to the Shitalakhya River Bangladesh”, B.Sc. Thesis (A.K.M Estiak Hasan), Department of Environmental Science And Disaster Management, Daffodil International University, Dhaka.
42. Joint supervisor: Susmita Hossain, “Analysis of metal concentrations in water-soil-vegetation of the Dhaleshari river: An overview of the challenge to achieve SDG.”, B.Sc. Thesis (Mahamuda Sultana Anita), Department of Environmental Science And Disaster Management, Daffodil International University, Dhaka
43. Joint supervisor: Md. Nue E Alam, “Apportionment of carcinogenic arsenic in drinking water at Rajshahi district using Atomic Absorption Spectroscopy and estimation of associated health risk”, MS Thesis (Md. Habibur Rahman), Department of Chemistry, University of Rajshahi (RU), 2022

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44. Joint-supervisor: Selina Yeasmin, “A Study into Radionuclide Distribution Patterns in Environmental Specimens Collected from Chattogram Division”, MS Thesis (Mohammad Shafiqul Alam), Department of Nuclear Engineering, University of Dhaka, April, 2023.
45. Joint-supervisor: Selina Yeasmin, “Naturally Occurring Radioactive Material’s activity in Soil Samples collected from Khulna Division”, MS. Thesis (Jubair Al Mahmud), Department of Nuclear Engineering, University of Dhaka, April, 2023.
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49. Joint-supervisor: Selina Yeasmin, “Measurement of outdoor environmental gamma radiation dose rate using gamma scout around some pharmaceutical companies at Tongi under Gazipur, Project (Nadia Sarker), Department of Nuclear Engineering, University of Dhaka, February 2023.
50. Joint-supervisor: Dr. Mohammad Sohelur Rahman, “Real-time radiation monitoring around the largest hospitals campuses in central and western Bangladesh by In-Situ Method and estimation of radiation risk on public health”, MS Thesis (Md. Mostafizur Rahman), Physics Discipline, Khulna University, July 2022.
51. Joint-supervisor: Dr. Mohammad Sohelur Rahman, “Real-time radiation monitoring at indoor & outdoor of two large hospitals and evaluation of radiation risk on worker & public”, MS Thesis (Nazia Hassan), Department of Physics, JU, August 2022.
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Materials Science Division, AECD

62. Co-supervisor: Dr. Mohammed Nazrul Islam Khan, “Synthesis & Characterization of Oxide Double Perovskite Ba_2BiVO_6 for Solar Cell Applications ”, M.Sc. Thesis (A.K.M. Sarwar Hossain Faysal), Department of Electrical and Electronic Engineering university of Dhaka, July, 2022
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72. Co-supervisor: Dr. Engr. Sheikh Manjura Hoque, “Facile Synthesis of $\text{Bi}_{0.85}\text{La}_{0.15}\text{FeO}_3$ to Study Multiferroic Properties with the Heat Treatment” M.S. Thesis (Israt Jahan Isha), Department of Physics, University of Chittagong, Chittagong, March, 2023.
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Medical Physics Division, AECD

88. Join-Supervisor: Dr. Rajada Khatun & Shirin Akter, “A Novel Dosimetry Approach for Computer Tomography using Polymethyl Methacrylate Phantom”, B.Sc. Thesis (Tanzila Akter Urme & Ruksana Akter Juma), Department of Medical Physics and Biomedical Engineering, Gono Bishwabidyalay, Savar, Dhaka, Bangladesh, October 2022.
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INSTITUTE OF RADIATION AND POLYMER TECHNOLOGY (IRPT), AERE

93. **Co- Supervisor** Md. Serajum Manir, SSO, IRPT. Gamma induced synthesis and characterization of ZnO nanoparticles for photo-catalytic application. Md. Sumon Reza Roll-195, Session: 2022, Department of Chemistry, Jahangirnagar University.
94. **Co-Supervisor** Md. Rabiul Islam, SSO, IRPT. Gamma induced synthesis and characterization of CuO for photocatalytic application. nanoparticles (Internship) Mohammad Rasel Roll-197, Session: 2022, Department of Chemistry, Jahangirnagar University
95. **Co- Supervisor** Md. Serajum Manir, SSO, IRPT. Gamma induced synthesis and characterization of BaO nanoparticles for photo-catalytic application. (Internship), Basudev Chandra Roy Roll-200, Session: 2022, Department of Chemistry, Jahangirnagar University.

INSTITUTE OF NUCLEAR SCIENCE AND TECHNOLOGY (INST), AERE

Nuclear Radiation and Chemistry Division, INST

96. Supervisors: Dr. Salma Sultana, “Preparation and characterization of chitosan/N,N-dimethyl acrylamide/2-hydroxyethyl acrylate based hydrogel by gamma radiation technology and it’s application in industrial dye (congo red) and heavy metal (chromium) removal”, M.S. Thesis, (student’s name: Salma Amin), Department of Applied Chemistry and Chemical Engineering, Noakhali Science and Technology University (NSTU), Noakhali, submitted on June 2023.

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100. Supervisors: Dr. Nazia Rahman, “Assessment of water pollution caused by tannery effluents at Hazaribagh, Dhaka and its mitigation strategies” Ph.D. Thesis, (student’s name: Fatema-Tuj-Zohra), *Department of Applied Chemistry and Chemical Engineering*, University of Dhaka., submitted on April 2023.
101. Supervisors: Dr. Nazia Rahman, “Preparation of efficient adsorbent through radiation grafting of glycidyl methacrylate on non-woven polypropylene fabric” M.S. Thesis, (student’s name: Rounik Jahan), *Department of Applied Chemistry and Chemical Engineering*, University of Dhaka., submitted on January 2023.

Reactor and Neutron Physics Division, INST

102. Joint-supervisor: Dr. Mohammad Amirul Islam, “Application of neutron activation analysis for elemental analysis in sediments of the Bongshi river near Dhaka Export Processing Zone”, M.Sc. Thesis, (Md. Rabiul Islam), Department of Physics, Jahangirnagar University, Savar, Dhaka, 2022.
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104. Joint-supervisor: Dr. Rahat Khan, “Distribution of rare earth elements, Th and U in soil around Brick-Kilns: Tracing anthropogenic incorporation”, M.Sc. Thesis, (Md. Kawsaruzzaman), Department of Environmental Science, Jahangirnagar University, Savar, Dhaka, 2023.
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Reactor Physics and Engineering Division, INST

112. Dr. Md. Jahirul Haque Khan, (Joint-Supervisor), “Analysis of Neutronics Safety Parameters and Core Burnup Lifetime of BAEC TRIGA Mark-II Research Reactor Using the Deterministic TRIGAP and TRIGLAV Codes” M.Sc. in Engineering (Md. Rakibul Hasan) Department of Nuclear Engineering, Military Institute of Science and Technology (MIST), submitted on April 2023.

Isotope Hydrology Division, INST

113. Joint Supervisor: Dr. Md. Moniruzzaman, “Appraisal of Groundwater Source, Contamination, And Health Risk Assessment of Meherpur District, Bangladesh”, M.Sc student, (Student’s name: Nazmus Shalihin), Department of Chemistry, Mawlana Bhashani Science and Technology University, Submitted on December, 2022.
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Health Physics and Radioactive Waste Management Unit, INST

115. Supervisor/Co-supervisor: Engr. Mohammad Monzur Hossain Khan, Dr. Khandoker Asaduzzaman and Md. Abu Haydar, “Characterization and Management of Solid Radioactive Waste Stored in CWPSF, INST: A Gamma Spectrometry Approach”, M.Sc Thesis (Students name: Istiak Uddin Sazzad), Department of Nuclear Engineering, University of Dhaka, submitted on April, 2023.
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INSTITUTE OF FOOD AND RADIATION BIOLOGY (IFRB), AERE

Food Safety and Quality Analysis Division, IFRB

119. Supervisor/co-supervisor: Dr. Kamruzzaman Munshi, CSO, “Shelf life extension (long term preservation and elimination of pathogenic microorganism by gamma radiation) , quality analysis and measurement of toxic element in ready to eat meat product available in local super market” M.Sc thesis (student’s name: Sunjida Rahman), Department of Microbiology, Stamford University, Submitted on June 2023.
120. Supervisor/co-supervisor: Dr. Shakhawat Hussain, CSO, “Changes in microbial diversity and nutritional properties during the traditional fermentation of rice” M.Sc thesis (student’s name: Ayesha Esrat), Department of Microbiology, Stamford University, Submitted on June 2023.

Microbiology and Industrial Irradiation Division, IFRB

121. Supervisor/Co-supervisor: Dr. Mohammad Omar Faruk, “Assessment of Pharmaceutical Waste Water for Traces of Antibiotics Residue and Presence of Drug Resistant Pathogens”, MS Thesis (student’s name: Kanij Mahjabin), Department of Microbiology, Jahangirnagar University, submitted on March 2023.
122. Supervisor/Co-supervisor: Dr Abdullah-Al-Mahin, “Study on the prevalence of foodborne pathogens in street-vended fresh-cut fruits and salads in Dhaka city using cultural and molecular techniques”, MS Thesis (student’s name: Nazmoon Nahar), Dept. of Biotechnology and Genetic Engineering, Noakhali Science and Technology University, submitted on December 2022.
123. Supervisor/Co-supervisor: Dr Abdullah-Al-Mahin, “Evaluation of probiotic potentials of lactic acid bacteria (LAB) isolated from freshwater fish intestines for beneficial supplementation in fish feed”, MS Thesis (student’s name: Edee Amin), Dept. of Microbiology, University of Chittagong, submitted on May 2023

Agrochemical and Environmental Research Unit, IFRB

124. Supervisor/Co-Supervisor: Zeenath Fardous (Supervisor) and Meherun Nesha (Co- Supervisor) “Assessment of Heavy metals (Pb, Fe, Cu, Cr, Zn, Cd) in Hematological malignant Patient and find out a possible correlation among Heavy metals and liver abnormalities in Malignant patient in Bangladesh ” M.S thesis (Sharmin Islam), Department of Biochemistry and Molecular Biology, Jahangirnagar University, 2022.

Cytology and Biocontrol Research, IFRB

125. Joint Supervisor: Dr. Md. Hasanuzzaman, “Effects of insecticides on different organs of three indigenous fish species (*Channa punctatus*, *Heteropneustes fossilis* and *Anabas testudineus*) in the wetlands of Dhamrai area, Bangladesh”, PhD Thesis (student’s name: Mohammad Sohiful Islam), Department of Zoology, Faculty of Biological Sciences, Jahangirnagar University, Savar, Dhaka, Bangladesh. PhD degree awarded on October, 2021.
126. Co-supervisors: Dr. Farzana Yesmin and Dr. Md. Hasanuzzaman, “Assessment of some physico-chemical parameters of water, macrobenthos community and cytogenetic analysis of Chironomids (*Chironomus* spp.) of the Bangshi River, Savar, Dhaka”, M. Sc. Thesis (student’s name: Sumona Barman), Department of Zoology, Faculty of Biological Sciences, Jahangirnagar University, Savar, Dhaka, Bangladesh. MS result published on 23 May, 2022.

Veterinary Drug Residue Analysis Division, IFRB

127. Supervisor: Dr. Md. Ibrahim Hossain and Dr. Md. Nazrul Islam, Thesis title: “Determination of Sulfonamides, trimethoprim and dapsoner residues in commercially available chicken eggs by chromatography tandem mass spectrometry (LCMS/MS)” MS Thesis (Md. Sala Uddin Ahmed), Department of Biochemistry and Molecular Biology, Jahangirnagar University, Dhaka, Submitted on January 2023.
128. Supervisor: Dr. Md. Mahbul Morshed and Dr. Mohammad Jahurul Islam, Thesis title: “Prevalence of tetracycline residues in poultry chicken eggs in four selected districts Dhaka division” MS Thesis (Rayan-Ul-Islam), Department of Biochemistry and Molecular Biology, Jahangirnagar University, Dhaka, Submitted on January 2023.

Gamma Source Division (GSD)

129. Co-Supervisor : Dr. Md. Firoz Mortuza, PSO. Thesis title: Determination of Phytosanitary Gamma Radiation Dose and Molecular Characterization of Rice Weevil (*Sitophilus oryzae*) (*Coleoptera: Curculionidae*) Name of Student: Nadia Tabassum Mim (MS student) Department of Zoology, Dhaka University M.S. Session: 2020-21
130. Co-Supervisor : Dr. Md. Firoz Mortuza, PSO. Thesis title: Determination of Phytosanitary Gamma Radiation Dose of Lepidopteran pest, *Leucinodes orbonalis* of selected vegetable brinjal, *Solanum melongena* Name of Student : Nigar Sultana (MS student) Department of Zoology, Dhaka University M.S. Session: 2020-21

INSTITUTE OF TISSUE BANKING AND BIOMATERIALS RESEARCH (ITBBR), AERE

131. Joint-Supervisor: Dr. S. M. Asaduzzaman, “Fabrication and Characterization of Carbon Nanotube Incorporated Hydroxyapatite Based Scaffolds for Bone Tissue Engineering”, M.Sc. Thesis (Esrat Jahan Shorna), Department of Biochemistry and Molecular Biology, MawlanaBhashani Science and Technology University, Santosh, Tangail, February 2023.
132. Joint-Supervisor: Dr.S.M. Asaduzzaman, “The Synergistic Effect of Decellularized Human Amniotic Membrane and Nigella sativa Gel on Burn Wound Healing in Rat Model”, M.Sc. Thesis (Saiful Islam Rayhan), Department of Biochemistry and Molecular Biology, MawlanaBhashani Science and Technology University, Santosh, Tangail, February 2023.

INSTITUTE OF COMPUTER SCIENCE (ICS), AERE

Software Engineering Division (SED), ICS

133. Project supervision of an undergraduate student. Project title: *“Design and Development of Journal Management System”*

INSTITUTE OF NUCLEAR MEDICAL PHYSICS (INMP), AERE

134. Co-supervisor: Md. Masud Parvej (SSO), “Specification of Setup Margin (SM) for Planning Target Volume (PTV) in Left Breast Cancer Patients for Specific LINAC Machine”, M.Sc. Thesis student's name: Mr. Zulkar Naen, Master of Science, Department of Medical Physics and Biomedical Engineering (MPBME), Gono University, Savar, Dhaka, Bangladesh - June, 2022
135. Co-supervisor: Md. Masud Parvej (SSO), “Evaluation of the Shielding Design of the LINAC Bunker at the New INMP Building, AERE, BAEC, Bangladesh”, M.Sc. Thesis student's name: Ms. Nahida Sultana, Master of Science, Gono University, Savar, Dhaka.
136. Co-supervisor: Md. Abul Hasnat; Transmission Factor of Medical LINAC installed at Nuclear Medical Physics Institute, BAEC" - Sayed Bony Amin is a M.Sc. student of the department of Physics at Uttara University Dhaka. " June, 2022
137. Clinical-Supervisor: Md. Abul Hasnat (SO): “Study of Medical LINAC and Quality Control Results by Analyzing PDD at Institute of Nuclear Medical Physics”- Akhtar-Uz-Zaman Shabuj, Master of Science, department of Physics at Uttara University, Dhaka. - June, 2022
138. Clinical-Supervisor: Md. Abul Hasnat (SO): “Study on Applicability of Slab Phantom Instead of 1D Water Phantom for QC of a Medical Linear Accelerator”- Md. Tareq Aziz, Master of Science, department of Physics at Uttara University, Dhaka. - December, 2022
139. Clinical-Supervisor: Md. Abul Hasnat (SO): “Small Field Dosimetry of Electron Beams and Photon Contamination Analysis in the Tail Region of the PDDs of a Medical LINAC”- Sadip Barua, Master of Science, department of Physics at University of Chittagong - January 2023

INSTITUTE OF ENERGY SCIENCE (IES, AERE

140. Supervisor/Co-supervisor: Dr. Mohammad Mizanur Rahman, “Source Term Analysis and Assessment of Dispersion Characteristics for the TRIGA Mark-II Research Reactor in Bangladesh Under a Severe Accidental Scenario.”, MSc Thesis (Sumiya), Department of Physics, Hajee Mohammad Danesh Science and Technology University, 2022, Completed.
141. Supervisor/Co-supervisor: Dr. Mohammad Mizanur Rahman, “Comparison of Radiological Impact between Hypothetical Long Term Station Blackout (LTSBO) and Loss of Coolant Accident (LOCA) of Rooppur Nuclear Power Plant.”, MSc Thesis (Saiyed Sajib Hossain), Department of Physics, Jahangirnagar University, 2023, On-going.
142. Supervisor/Co-supervisor: Dr. Mohammad Mizanur Rahman, “Radiological Safety Analysis due to Accidental Release of ^{137}Cs , ^{131}I , ^{133}Xe , $^{85\text{m}}\text{Kr}$, and ^{90}Sr from TRIGA Research Reactor”, MSc Thesis (Faozia Silvee), Department of Physics, Jahangirnagar University, 2023, On-going.

NATIONAL INSTITUTE OF NUCLEAR MEDICINE AND ALLIED SCIENCES (NINMAS), SHAHBAG

143. Supervisor: Prof. Dr. Fatima Begum, “Association of Pre-operative Thyroglobulin and Thyroglobulin Antibody Level with Metastasis Present During Diagnosis of Differentiated Thyroid Carcinoma”, MD

Thesis (student name: Dr. Umme Farzana Akter), Department of National Institute of Nuclear Medicine & Allied Sciences, Bangabandhu Sheikh Mujib Medical University (BSMMU), submitted on November 2022.

144. Supervisor: Prof. Dr. A. K. M. Fazlul Bari, “Diagnostic Performance of Blood Flow Volume of Superior Thyroid Artery Done by Color Doppler Ultrasonogram for Diagnosis of Graves’ Thyrotoxicosis”, MD Thesis (student name: Dr. Faria Tasnuva Chowdhury), Department of National Institute of Nuclear Medicine & Allied Sciences, Bangabandhu Sheikh Mujib Medical University (BSMMU), submitted on November 2022.
145. Supervisor: Prof. Dr. Nasreen Sultana, “Association of Carotid Intima-Media Thickness (CIMT) with Alzheimer’s Disease (AD) Among Dementia Patients Attended in NINMAS”, MD Thesis, (student name: Dr. Ashrafi Anar), Department of National Institute of Nuclear Medicine & Allied Sciences, Bangabandhu Sheikh Mujib Medical University (BSMMU), submitted on April 2023.
146. Co-Guide: Prof. Dr. A. K. M. Fazlul Bari, “Premature Atherosclerotic Changes And Its Relation With Disease Activity In Pediatric Systemic Lupus Erythematosus Patients”, MD Thesis (student name: Dr Shafiqul Islam), Department Of Paediatrics, Bangabandhu Sheikh Mujib Medical University (BSMMU), Submitted on November 2022.

PLANNING AND DEVELOPMENT DIVISION (PDD), BAEC HQ

147. Co-supervisor: Dr. Syed Mohammad Hossain, Director, Planning & Development Division, “Redistributions of NORMs in and around a gas-field (Shabazpur, Bangladesh): radiological risks assessment”, PhD thesis (PhD student name: Mahbuba Begum), Electrical and Electronic Engineering Department, Dhaka University, Completed on 8th December 2022.

NUCLEAR SAFETY, SECURITY AND SAFEGUARDS DIVISION (NSSSD), HQ

148. Measurement of Backscattering Factor (BSF) for X-rays Calibration beam with Various Phantom using Ionization Chamber and Thermoluminescence Dosimeter (TLD) Rokshana Parvin Master of Science (MS) **Nuclear Engineering** Military Institute of Science and Technology, Bangladesh September 2022
149. Beam Quality Correction Factor of High Energy Electron Beam Dosimetry from Medical LINAC Santunu Purohit Master of Philosophy (M. Phil)**Physics** University of Chittagong November 2022
150. Evaluation of Calibration Factors and Sensitivity Analysis of Neutron Measurement Devices for Am-Be Neutron Field Rubayet Alam Bachelor of Science (B.Sc. Hons)**Nuclear Engineering** Military Institute of Science and Technology, Bangladesh February 2023
151. Measurement of Photo-Neutron Dose for 15 MV Photon Beam from Medical Linac Ummey Habiba Musfika Master of Science (MS)**Physics** University of Chittagong March 2023
152. Dosimetric Measurement of Therapeutic Photon Beam by Optically Stimulated Luminescence (OSL) and Thermoluminescence Dosimeter (TLD) MsMorshida Master of Science (MS)**Physics** University of Chittagong December 2023
153. Dosimetric characterization of small irradiation fields for the ⁶⁰Co teletherapy beam with various detectors Tanjina Akhter Master of Science (MS)**Physics** University of Chittagong December 2023
154. Spectroscopy and dosimetry of calibration neutron beam by experimental measurement and Monte Carlo N-particle (MCNP) simulation at SSDL facilities in Bangladesh Atomic Energy Commission Md. Hamidul Haque Master of Science (MS)**Physics** University of Chittagong December 2023
155. Experimental measurement and Monte Carlo N-Particle (MCNP) simulation of 60 kV to 320 kV X-ray calibration beam at SSDL facilities Md Anisur Rahman Master of Science (MS)**Physics** University of Chittagong December 2023

ATOMIC ENERGY CENTRE, CHATTOGRAM (AECC)

156. Co-supervisor: Dr. Shahadat Hossain, “Present Status of Heavy Metal Concentration In Soil of Halda River, Chattogram, Bangladesh.” M. Sc Thesis (student’s name: Sayeda Halida Eadib), Department of Zoology, Chittagong University, submitted on December 2022.

157. Co-supervisor: Dr. Shahadat Hossain, "Assessment of Heavy Metals Contamination in Water of Halda River; a Unique Carp Fish Breeding Area of Bangladesh." M. Sc Thesis (student's name: Afsana kamal), Department of Zoology, Chittagong University, submitted on December 2022.
158. Co-supervisor: Nipa Deb, "Evaluation of Toxic Metals Contamination in Fishes of Halda River - An Approach towards Risk Assessment." M. Sc Thesis (student's name: Jakia Sultana), Department of Zoology, Chittagong University, submitted on November 2022.
159. Co-supervisor: Nipa Dev, "Study on Evaluation of Trace Elements in RIPARIAN Vegetation of Halda River, Chattogram, Bangladesh." M. Sc Thesis (student's name: Moitree Saha), Department of Zoology, Chittagong University, submitted on December 2022.
160. Co-supervisor: Dr. Shahadat Hossain "Assessment of natural radioactivity concentration in surface soil of Rangamati district by measuring activity concentration of natural radionuclides and radiological hazard." M. Sc Thesis (student's name: Pranta Acherjee), Department of Physics, Chittagong University, submitted on December, 2022.
161. Co-supervisor: Dr. AKM Saiful Islam Bhuiyan, "Measurement of Heavy Metals Concentration and associated Health Risk in the Soil of Cumilla District Systematic Gridding Method". M. Sc Thesis (student's name: Mohammad Sayeed Hossain), Department of Physics, Chittagong University, submitted on June, 2022.

CONSTRUCTION OF ROOPPUR NUCLEAR POWER PLANT PROJECT

162. Supervisor: Dr. Mohammad Shawkat Akbar "A numerical Approach to Design and Develop Effective Physical Protection System for Nuclear Installation", PhD Thesis (students name: AZM Salahuddin), Bangladesh University of Professionals, submitted on July 2022

XVI. INTERNATIONAL/NATIONAL PUBLICATIONS

ATOMIC ENERGY CENTRE (AEC), DHAKA

Chemistry Division, AECD

International

1. M. Nur E. Alam, M. Mozammel Hosen, A. K. M. Atique Ullah, M. A. Maksud, S. R. Khan, L. N. Lutf, Tasrina Rabia Choudhury, Shamshad B. Quraishi, "Pollution Characteristics, Source Identification, and Health Risk of Heavy Metals in the Soil-Vegetable System in Two Districts of Bangladesh, Biological Trace Element Research", January 2023 <https://doi.org/10.1007/s12011-023-03558-7>
2. M. Nur E. Alam, M. Mozammel Hosen, A. K. M. Atique Ullah, M. A. Maksud, S. R. Khan, L. N. Lutf, Tasrina Rabia Choudhury, Shamshad B. Quraishi, "Biological Lead Exposure of Four Biologically Important Common Branded and Non-branded Spices: Relative Analysis and Health Implication, Biological Trace Element Research", January 2023 <https://doi.org/10.1007/s12011-022-03553-4>
3. Anwar, A , Alam, B , Alam, KS , Chowdhury, AA, Quraishi, SB, Ferdaus, J, Hossain, Z, Mahmud, A, Sarker, S, Alam, RA, Rahman, IZ, Rahman, S, Tabassum, T, Kamal, M, Qader, A, "Levels of Essential And Toxic Elements In Serum of Patients with Chronic Kidney Disease: A Study From an Urban Renal Center In a Developing Country, Epidemiology, outcomes and health service research related to CKD or its complications. Vol 8, Issue 3, Supplement, S164, March 2023 WCN 23 0077, <https://doi.org/10.1016/j.ekir.2023.02.369>
4. Hossain MM, Hannan ASMA, Kamal MM, Hossain MA and Quraishi SB, "Appraisal and Validation of a Method (MVU-AAS) Used for the Detection of a Toxic Metal Mercury (Hg) in Poultry Feed Available in Bangladesh", Austin J Anal Pharm Chem. 2022; 9(2): 1147. doi:10.26420/austinjanalphasechem.2022.1147
5. Md. Mosharaf Hossain, Abu Sayeed Md. Abdul Hannan, Md. Mostofa Kamal, Mohammad Abul Hossain, and Shamshad B. Quraishi, "Appraisal and validation of a method used for detecting heavy metals in poultry feed in Bangladesh", Veterinary World, 2022, 15(9): 2217-2223. www.doi.org/10.14202/vetworld.2022.2217-2223

6. Yeasmin N. Jolly, Md. Refat Jahan Rakib , M. SadmanSakib, M. Ashemus Shahadat , Arafat Rahman ,Shirin Akter, JamiulKabir, M. Safiur Rahman, Bilkis A. Begum,Rubina Rahman, AbdelmoneimSuliman, NissrenTamam , Mayeen Uddin Khandaker and Abubakr M. Idris “Impact of Industrially Affected Soil on Humans: A Soil-Human and Soil-Plant-Human Exposure Assessment”.Toxics 2022, 10, 347. <https://doi.org/10.3390/toxics10070347>
7. Md, Refat Jahan Rakib , Md Rahman, Amarachi PaschalineOnyena, Rakesh Kumar, AniruddhaSarker, M Belal Hossain, Abu Reza Md Islam, Md Islam, Yeasmin N. Jolly,Abubakr M Idris, Mir Mohammad Ali, Muhammad Bilal, Xian Sun “A comprehensive review of heavy metal pollution in the coastal areas of Bangladesh: abundance, bioaccumulation, health implications and challenges.” Environmental Science and Pollution Research, 29, 67532-67558 (2022).
8. M Belal Hossain, ZobaerMasum, M Safiur Rahman, Jimmy Yu, Md Abu Noman, Yeasmin N. Jolly, Bilkis A Begum, Bilal AhamadParay, Takaomi Arai “Heavy metal accumulation and phytoremediation potentiality of some selected mangrove species from the world’s largest mangrove forest.” Biology, 11(8), 1144, (2022).
9. Beauty Akter, Mashura Shammi ,Md Ahedul Akbor, Sabina Yasmin, Aynun Nahar , Shirin Akhter, Yeasmin Nahar Jolly, Md Khabir Uddin.“Preparation and characterization of biochar: A case study on textile and food industry sludge management”. Case Studies in Chemical and Environmental Engineering 7, 2023, 100282. <https://doi.org/10.1016/j.cscee.2022.100282>
10. Maheen Mehnaz, Yeasmin N. Jolly, A. K. M. Rashidul Alam, Jamiul Kabir, Shirin Akter, Khan M. Mamun, Arafat Rahman and Md Mahfuz Islam “Prediction of Hazardous Effect of Heavy Metals of Point Source Wastewater on Fish (*Anabas cobojius*) and Human Health”. Biol Trace Elem Res (2023), 201(60, 3031-3049. <https://doi.org/10.1007/s12011-022-03378-1>.
11. Yeasmin. N. Jolly , Md. Refat Jahan Rakib , Rakesh Kumar , Shahida Sultana, Sheikh M. Mizanur Rahman, JamiulKabir Shirin Akter , Khan M. Mamun ,Konika Jannat Fatema ,Maheen Mehnaz, Prasenjit Pal, Eijaz Ahmed Bhat, Bilal Ahamad Paray, Prabhakar Sharma, Prosun Bhattacharya.“Evaluation of surface water quality near pollution sources in Buriganga River and deciphering their probable emergence, ecological, and health risk aspects”,Journal of Regional Studies in Marine Science. 63,102-988 , (2023), <https://doi.org/10.1016/j.rsma.2023.102988>
12. Yeasmin N. Jolly , Md. Refat Jahan Rakib , Rakesh Kumar , Abu Reza Md. Towfiqul Islam , Atahar Rabby , Khan Mohammad Mamun , Shirin Akter , Jamiul Kabir , Taseen Jubair Bhuiyan , Abdullah Mohammad Sarwaruddin Chowdhury , Abubakr M. Idris “Deciphering the source of heavy metals in industrially affected river sediment of Shitalakshya River, Bangladesh, and potential ecological and health implications”. Journal of Hazardous Materials Advances. Volume 10 ,May 2023, 100268 .<https://doi.org/10.1016/j.hazadv.2023.100268>.
13. M Belal Hossain, Jimmy Yu, As-Ad Ujjaman Nur, Partho Banik, Yeasmin N Jolly, Md Al-Mamun, Takaomi Arai, Mohammed Fahad Albeshr, “Microplastic in surface water from a mighty subtropical estuary: first observation on occurrence, characterization and contamination assessment” (2023). Environmental research, 226, 115594.
14. Refat Jahan Rakib, Gabriel Enrique De-la-Torre, Yeasmin N Jolly, Sultan Al Nahian, Nazrul Islam Khan, Abubakr M Idris, “First record on plastigomerate and pyroplastic pollution in the world’s longest natural beach”, (2023). Science of the total Environment, 164369.
15. Md Badiuzzaman Khan, Shamsunnahar Setu, Niger Sultana, Sneha Gautam, Bilkis Ara Begum, Mohammed Abdus Salam, Yeasmin N. Jolly, Shirin Akter, Mohammed Mizanur Rahman, Badal Chandro Shil, Sadea Afrin, “ Street dust in the largest urban agglomeration: pollution charecteristics, source apportionment and health risk assessment of potentially toxic trace elements”, (2023). Stochastic Environmental Research and Risk Assessment, <https://doi.org/10.1007/s00477-023-02432-1>
16. Md. Moudud Ahmed , As-Ad Ujjaman Nur , Yeasmin N. Jolly , Md. RakebUl Islam, Mohammad Saifur Rahman , Shirin Akter , Jimmy Yu, Mohammed Fahad Albeshr, Takaomi Arai and Mohammad Belal Hossain, “Contamination and Ecological Risk Evaluation of Metals in Sediments from a Wetland of International Importance (Ramsar Site),” Sustainability 2023, 15, 7753.<https://doi.org/10.3390/su15107753>.

17. Begum, B.A., Shahriar, M., Eunus, M., Ahmed, S., Chowdhury, M. A. H., Kader, S., Begum, & Yunus, M. (2022, September). Exposure to household air pollution (HAP) and measures of central hemodynamic parameters among Bangladeshi population-A cross-sectional study. In ISEE Conference Abstracts (Vol. 2022, No. 1).
18. Begum, B. A., Ahmed, S., Chowdhury, M. A. H., Kader, S. B., Shahriar, M. H., Eunus, M., & Yunus, M. (2022). Personal exposure to household air pollution and lung function in rural Bangladesh: A population-based cross-sectional study. *International Journal of Environmental Health Research*, 1-13.
19. Hossain, M.B., Masum, Z., Rahman, M.S., Yu, J., Noman, M.A., Jolly, Y.N., Begum, B.A., Paray, B.A., Arai, T. (2022). Heavy metal accumulation and phytoremediation potentiality of some selected mangrove species from the world's largest mangrove forest. *Biology* 2022, 11, 1144.
20. Ahsan, M.A., Rahman, M.S., Bhuiyan, M.A.Q., Rahaman, M.S., Rahman, M.T., Khan, M.A. (2022). Reuse of gamma-ray irradiated textile wastewater: implications on the growth of *Capsicum frutescens* plant. *Heliyon* 2022 Jul 20; 8(8):e10009.
21. Rahman, M.S., Akther, S., Ahmed, A.S.S., Saha, N., Kabir, M.J., Ahmed, M.K. (2022). Distribution, source apportionment of metal contents in some benthic and pelagic coastal fish species in Bangladesh: Risk to human health. *Marine Pollution Bulletin* 183 (2022) 114044.
22. Rahman, M.M., Yeasmin, M.S., Uddin, M.J., Hasan, M., Shaikh, M.A.A., Rahman, M.S., Maniruzzaman, M. (2023). Simultaneous abatement of Ni^{2+} and Cu^{2+} effectually from industrial wastewater by a low cost natural clay-chitosan nanocomposite filter: Synthesis, characterization and fixed bed column adsorption study. *Environmental Nanotechnology, Monitoring & Management* 20 (2023) 100797.
23. Ahmed, A.S.S.; Billah, M.M.; Ali, M.M.; Bhuiyan, M.K.A.; Guo, L.; Mohinuzzaman, M.; Hossain, M.B.; Rahman, M.S.; Islam, M.S.; Yan, M.; Cai, W. (2023). Microplastics in aquatic environments: A comprehensive review of toxicity, removal, and remediation strategies. *Science of the Total Environment* 876 (2023) 162414.
24. Bashar. M.A.; Molla, M.T.H.; Chandra, D.; Malitha, M.D.; Islam, M.S.; Rahman, M.S.; Ahsan, M.S. (2023). Hydrothermal synthesis of cobalt substitute zinc-ferrite ($\text{Co}_{1-x}\text{Zn}_x\text{Fe}_2\text{O}_4$) nanodot, functionalised by polyaniline with enhanced photocatalytic activity under visible light irradiation. *Heliyon* 9 (2023) e15381
25. Mubin, A.N., Arefin, S., Mia, M.S., Islam, A.R.M.T., Bari, A.B.M.M., Islam, M.S., Ali, M.M., Siddique, M.A.B., Rahman, M.S., Senapathi, V., Idrisi, A.M., Malafaia, G. (2023). Managing the invisible threat of microplastics in marine ecosystems: Lessons from coast of the Bay of Bengal. *Science of the Total Environment* 889 (2023) 164224
26. Khan, F.; Sajol, M.S.Z.; Kabir, M.; Kaiser, N.M.E.; Rahman, M.S.; Hasan, S.M.F. (2023). Combined application of EPANET and empirical model for possible formation of trihalomethanes in water distribution network of Chattogram city to identify potential carcinogenic health risk zone. *Heliyon* 9 (2023) e16615.
27. S. M. M. Rahman, M. A. Hossain, K. B. Hafiz , N. I. Hossain , M. N.Alam, M. S. Rahman , T. R. Choudhury, “Multi-dimensional approach for an environmental health assessment of a deltaic mangrove ecosystem, Sundarbans”, *Environmental Advances*, Vol. 12 (2023), 100377.
28. S. Ahmed, F.T.Zohra, T. R. Choudhury, M. Z. Alam, M.Nurnabi, “Adsorption of Cu(II) and Cd(II) with graphene based adsorbent: adsorption kinetics, isotherm and thermodynamic studies”, *Desalination and Water Treatment*, Vol. 285, (2023), pp. 167–179.
29. M. R. Hasan, M. Anisuzzaman, T. R. Choudhury, T. Arai, J. Yu, M. F. Albeshr, M. B. Hossain, “Vertical distribution, contamination status and ecological risk assessment of heavy metals in core sediments from a mangrove-dominated tropical river”, *Marine Pollution Bulletin*, Vol. 189, (2023)
30. M. Z. Alam, T. R. Choudhury, M. A. U. Mridha, “Arbuscular Mycorrhizal Fungi Enhance Biomass Growth, Mineral Content, and Antioxidant Activity in Tomato Plants under Drought Stress”, *Journal of Food Quality*, Vol. 2023, (2023), pp. 1-18.

31. F. Y. Nisa, M. A. Rahman, M. K. J. Rafi, M. A. N. Khan, F. Sultana, M. Majid, M. A. Hossain, J. I. Deen, M. Mannan, S. Saha, J. Tangpong, T. R. Choudhury, "Biosynthesized magnesium oxide nanoparticles from Tamarindus indica seed attenuate doxorubicin-induced cardiotoxicity by regulating biochemical indexes and linked genes", *Biomaterials Advances*, Vol. 146, (2023).
32. M. S. Islam, R. A. Mustafa, K. Phoungthong, A. R. M. T. Islam, T. Islam, T. R. Choudhury, M. H. Kabir, M. M. Ali, A. M. Idris, "Arsenic in the foodstuffs: potential health appraisals in a developing country, Bangladesh", *Environmental Science and Pollution Research*, Vol. 30, (2022), pp. 26938–26951.
33. T. R. Choudhury, J. Ferdous, M. M. Haque, M. M. Rahman, S. B. Quraishi, M. S. Rahman, "Assessment of heavy metals and radionuclides in groundwater and associated human health risk appraisal in the vicinity of Rooppur nuclear power plant, Bangladesh", *Journal of Contaminant Hydrology*, Vol. 251, (2022), 104072.
34. A. U. Nur, M. B. Hossain, P. Banik, T. R. Choudhury, S. I. Liba, M. F. Albeshr, V. Senapathi, T. Arai, J. Yu, "Microplastic contamination in processed and unprocessed sea salts from a developing country and potential risk assessment", *Chemosphere*, Vol. 308, Part 2, (2022), 136395.
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XVII. PAPER PRESENTED IN SEMINAR/SYMPOSIUM/ CONFERENCE/WORKSHOP

ATOMIC ENERGY CENTRE (AEC), DHAKA

Chemistry Division, AECD

International

1. "Coupling of redundancy analysis with geochemistry and mineralogy to assess the behavior of dust arsenic as a base of risk estimation in Dhaka, Bangladesh". M. S. Rahman (Invited Speaker) [IL-A2, p. 50-51], International Conference on Environmental Protection for Sustainable Development (ICEPSD-2022), 2-4 September, 2022, Dhaka University, Bangladesh.
2. "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" M.S. Rahman, B.A. Begum [FSM-O-02; p. 23-24], 1st International Conference on Nano-bio and Advanced Materials Engineering 2023 [07-08, January, 2023] Cox's Bazar, Bangladesh.
3. "Assessment and source apportionment of potential trace elements in PM2.5 with especial emphasis on seasonal variation in the capital city of Bangladesh, M. S. Rahman, Atmospheric Composition and the Asian Monsoon (ACAM), The 5th ACAM workshop, 8-10 June 2023, Dhaka, Bangladesh
4. "Microplastics in the environment: Identification of occurrence, characteristic and ecological risk", T. R. Choudhury, M. B. Hossain, Bangladesh Council of Scientific and Industrial Research (BCSIR) Congress -2022, Integrated Approach for Adapting 4IR, 01-03 December, 2022, IL-E5, pp. 260.
5. "Microplastics in the Environment: Occurrence, Spatial distribution and Risk Assessment", T. R. Choudhury, M. B. Hossain, 1st International Conference on Nano-bio and Advanced Materials Engineering (NAME 2023), January 7-8, 2023, Cox's Bazar, Bangladesh, EMS-I-01, pp. 59.
6. "Status of metals in serum and urine samples of chronic kidney disease patients in a rural area of Bangladesh: An observational study", S. Z. Zaman, T. R. Choudhury, T. I. Chowdhury, B. A. Begum, M. A. Islam, M. M. Rahman, Bangladesh Council of Scientific and Industrial Research (BCSIR) Congress - 2022, Integrated Approach for Adapting 4IR, 01-03 December, 2022, OP-G4, pp. 43.
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8. "A Novel Approach for Assessing Heavy Metal Contamination in Roadside Perennial Plants, Soil and Dust of Dhaka South City Corporation, Bangladesh", T. Ahshan, M. N. Alam, M. S. Rahman, S. B. Quraishi, M. M. Rahmand, T. R. Choudhury, International Conclave on Materials, Energy & Climate, University of Dhaka, Dhaka, Bangladesh, , 19-20 December, 2022, PP ICMEC A6118, pp.64-65.
9. "Analogy of Toxic Metals and Global Comparison with Saint Martin Island Coral Ecosystem: an Ecotoxicity Appraisal", K. B. Hafiz, S. F. F. Sowrav, S. M. M. Rahman, A. A. Khan, T. R. Choudhury, International Conclave on Materials, Energy & Climate, University of Dhaka, Dhaka, Bangladesh, , 19-20 December, 2022, PP ICMEC A6120, pp.65.
10. "Heavy Metal Toxicity in Water and Sediment of Sundarbans and Source Identification", S. F. F. Sowrav, K. B. Hafiz, S. M. M. Rahman, T. R. Choudhury, International Conclave on Materials, Energy & Climate, University of Dhaka, Dhaka, Bangladesh, , 19-20 December, 2022, PP ICMEC A6121 , pp.65-66.
11. "Impact of heavy metals in coral ecosystem of Saint Martin island: An ecotoxicity appraisal and global concern", K. B. Hafiz, M. Rahman, S. F. F. Sowrav, S. B. Quraishi, T. R. Choudhury, Bangladesh Council of Scientific and Industrial Research (BCSIR) Congress -2022, Integrated Approach for Adapting 4IR, 01-03 December, 2022, PP-127, pp. 367-368.
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45. Synthesis of B₄ cluster on Mo (112) surface, S. Hossain, and T. Nakagawa, ACS Spring Meeting 2023, Organized by American Chemical Society, Indianapolis, IN, USA, 26 – 30 March 2023.
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57. Structural, Electrical and Magnetic Properties of the Al^{3+} substituting in Ni-Zn-co Nano-spinel Ferrites for Electronic Devices, N.Jahan, J.I. Khandaker, H.N. Das and M.N.I.Khan, No. MS02-137, International Conference on Electronics and Informatics 2022, Atomic Energy Centre, Dhaka, 26-28 January, 2023, Dhaka, pp.59.
58. Enhanced Multiferroic Properties of Fe Based $BaTiO_3$ Ceramic with Y Substitution for Devoce application, K.S. Nitu, J.I. Khandaker, R.Rashid, H.N. Das and M.N.I.Khan, No. MS03-138, International Conference on Electronics and Informatics 2022, Atomic Energy Centre, Dhaka, 26-28 January, 2023, Dhaka, pp.59.
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60. Magnetic and Optical characteristics and Dielectric Response of Mn-Doped Ba-Sr Ca Titanate Ceramic Materials for Spintronic Devices Application, R. Tabassum, J.I. Khandaker, H.N. Das, R.Rashid, and M.N.I. Khan, No. PP51-134, International Conference on Electronics and Informatics 2022, Atomic Energy Centre, Dhaka, 26-28 January, 2023, Dhaka, pp.130.
61. Influence of Ni Substitution on Structure, Electrical and Magnetic Properties of $Ba_{1-x}Ni_xTi_{0.8}Fe_{0.2}O_3$ Ceramics, M.A. Elahe, K.Jaman, S.Akter, R. Rashid and M.N.I. Khan, No.PP52-136, International Conference on Electronics and Informatics 2022, Atomic Energy Centre, Dhaka, 26-28 January, 2023, Dhaka, pp.131.
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Very large scale integration (VLSI) technology division, IE

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252. Breast Metastasis with Concurrent Multiple Organs: an Unusual Presentation of Metastasis of Papillary Thyroid carcinoma, J. Ferdous, F. Begum, P. Akhter, S. N. Bailey and Z. Jabin, Bangladesh International Cancer Congress, Oncology Club, Army Golf club, Dhaka, 17-18 November, 2022, pp.
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255. “Application of a categorical classification for assessment of kidney undergoing intervention with obstructive features. Dr. Afroza Naznin 21st Annual Meeting of ARCCNM & 61st Annual Meeting of KSNM 2-6th November 2022
255. Role of Nuclear Medicine in Diagnostic & Therapeutic field” Dr. Samira Sharmin, Dr. Afroza Naznin CME of Sir Sallimullah Medical College & Mitford Hospital 27th November 2022
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257. Use of high frequency Ultrasound in detection and localization of soft tissue foreign body. (Poster presentation) Dr. Farida Yasmin National Conference on Physics 2023, 9-11th March 2023

258. Menopausal age of Differentiated Thyroid Carcinoma (DTC) patients after single dose of Radioiodine therapy–Single Institute based Experience. Dr. Samira Sharmin 26th National Conference of SNMB, 10-11th March 2023, Dinajpur.
259. Observation of Metastatic Pattern in bone scintigraphy in Triple Negative versus Triple Positive Breast Cancer patients : Experience of a Single Institute Dr. Afroza Naznin 26th National Conference of SNMB, 10-11th March 2023, Dinajpur.

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260. Low Parathormone Level Following Total Thyroidectomy – Observation of Patient Traits in A Single Institute”, Tuba-UI-Zannat Mou, Jharna Das, Md. Nazmul Hossain, S. M. Nazim Uddin, Ashima Pervin, Md. Abdul Mazid, Mehnaz Riffat, Md. Shahriar Muttakin and Md. Mahbubur Rahman, 26th National Conference of Society of Nuclear Medicine, Bangladesh on 10-11 March 2023.
261. Long Metastases in Differentiated Thyroid Carcinoma Children – A Case Report of Three Patients”, S M Nazim Uddin, Ashoke Kumar Paul, Jharna Das, Md. Nazmul Hossain, Tuba-UI-Zannat, Ashima Pervin, Md. Abdul Mazid, Mehnaz Riffat, Md. Shahriar Muttakin and Md. Mahbubur Rahman, 26th National Conference of Society of Nuclear Medicine, Bangladesh on 10-11 March 2023.
262. “Myocardial Perfusion Imaging (MPI)”, Dr Jharna Das, Power Point presented on weekly Scientific Seminar in Khulna Medical College Hospital, 17 January, 2023
263. Bone SPECT/CT: State-of-the art in Oncolgy”, Dr. Jharna Das, Power Point presented on weekly Scientific Seminar in Khulna Medical College Hospital, 09 May, 2023.

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264. Analysis of bone mineral density and associated risk factors for the people of southeastern region of Bangladesh: Single center study, P. K. Bhattacharjee, M. N. Khan, M. F. Muhtasim, A. A. Persi, N. A. Alim and M. S. Hossain, National Conference of Society of Nuclear Medicine, Bangladesh, BLC, Dinajpur, 10-11 March, 2023.

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266. False Positive Result in Renography due to Extravasation of Radiotracer : A Case Report : Abdul Karim, Rowshan Ara, Md. Asaduzzaman, Harun-or-Rashid, Ashik Ullah, Jubair Ahmed, Ishaque Ali, Nazim Uddin.

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267. Shibli Nishad Alam “Outcome of patients after 5 years of receiving radioactive iodine ablation for differentiated thyroid carcinoma at INMAS, Rajshahi”, 26th National Conference of SNMB, Dinajpur.

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268. Professor Dr. Hafizur Rahman , attuned as a chairperson of Proffered Scientific Session, 26th National Conference , SNMB, 10-11March, 2023

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270. Evaluate the Slab Thickness of the New LINAC Bunker at the INMP, AERE, BAEC, Bangladesh. **Masud Parvej***, Nahida Sultana, Abdur Rahim, Sarmin Sultana, Abul Hasnat,M M Ahasan 18th ICRT of WARMTH,1-6 May, 2023
271. Development of Brachytherapy Facility at Institute of Nuclear Medical Physics (INMP): Our Concerns and Suggestions regarding Radiation Safety in a Brachytherapy Facility.A. Rahim, M. S. Sultana, M. M. Parvej, M. A. Hasnat, M. J Hosen, S. Alim, M. R. Islam & M. M. Ahasan National Conference on Physics – 2023, 9-11 March 2023

272. Study on the Variation of PDD of A Medical Linear Accelerator for Different Energy and Field Size at Institute of Nuclear Medical Physics. M. A. Shabuj, M. A. Hasnat, M.T. Aziz, M.S. Sultana, A. Rahim, M.R. Islam, National Conference on Physics, 9-11 March 2023

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274. Natural Radioactivity Assessment in various Tiles used for Building purposes in Bangladesh. S. Das, N.S. Resma, R. Roy, and S. Hossain. National Conference on Physics 2023, Bangladesh Physical Society (9-11 March 2023)
275. Distribution of Naturally occurring radio nuclide (^{226}Ra , ^{232}Th , and ^{40}K) in the sediment of Feni River. S. Das, S. Zaman, N.S. Resma, S. Bhomik, S.R. Chakraborty, A.K.M. R. Rahman, R. Roy, N. Deb, S. Hossain. National Conference on Physics 2023, Bangladesh Physical Society (9-11 March 2023)

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276. “জাতির পিতা বঙ্গবন্ধু শেখ মুজিবুর রহমান এর ঐতিহাসিক নেতৃত্ব এবং দেশের উন্নয়ন”, ডঃ মোঃ শাকিল আহমেদ (মূলপ্রতিপাদ্য বিষয় উপস্থাপন), ২৬ মার্চ মহান স্বাধীনতা ও জাতীয় দিবস ২০২৩ উদযাপন উপলক্ষ্যে আলোচনা অনুষ্ঠান, ২৮ মার্চ ২০২৩, ড. আনোয়ার হোসেন অডিটোরিয়াম, বাপশক, ঢাকা।

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