ANNUAL REPORT
July 2019 – June 2020

BANGLADESH ATOMIC ENERGY COMMISSION

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EDITORIAL BOARD

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Introduction

Bangladesh Atomic Energy Commission (BAEC) was founded in February 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 & development (R&D) programs 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 & agriculture, industry, power, health or medicine and Environ. protection.

Programs 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 programs 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 & Allied Sciences (NINMAS) and 14 Institute of Nuclear Medicine & 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 programs.

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.

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 2019 to June 2020 in the various fields of nuclear science & technology are described 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 upto 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 Programa, particularly in the field of Environ. pollution, nuclear analytical techniques in material analysis and Environ. studies. 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

Activities

1. Research and Development Work(s)

Advanced Analytical Chemistry

1.1 Participation in proficiency testing for the analysis of trace elements in milk powder and canned crab organized by FAPAS

S. B. Quraishi, T. R. Choudhury, A. K. M. A. Ullah, M. N. Alam, M. R. Islam, M. M. Hosen, M. A. Maksud, S. R. Khan and L. N. Lutfa

The Analytical Chemistry Laboratory (ACL) of Chemistry Division is an ISO/IEC 17025:2005 accredited laboratory. According to the standards, in order to maintain the laboratory accreditation, it is mandatory to participate in the proficiency testing (PT) at least once in a year organized by any internationally recognized standard/reference laboratory and secure satisfactory results that ensure the quality of analyses, validity of the methods used and performances of analysts as well as instruments. Therefore, the main objective of this program was to meet the criteria set by the ISO/IEC 17025 standard in order to maintain the laboratory

accreditation. Analytical Chemistry Laboratory has participated in proficiency testing (PT) namely 'Food Analysis Performance Assessment Scheme' by FAPAS, UK for the analysis of Pb, Cd, As and Hg in canned crab; Pb, Cd and As in milk. The laboratory has secured satisfactory results for the quantification of trace elements quantified by different forms of Atomic Absorption Spectrophotometry (AAS) technique. The results indicate the capability of the laboratory to provide quality data for the quantification of trace elements in different food samples.

1.2 Development of a FAAS method for the quantification of lead, Cadmium and arsenic in food items

S. B. Quraishi, T. R. Choudhury, A. K. M. A. Ullah, M. N. Alam, M. R. Islam, M. M. Hosen, M. A. Maksud, S. R. Khan and L. N. Lutfa

Food is a prequisite for our living and in our daily life. we consume different forms of food regularly. Due to natural and anthropogenic activities, the environment is being polluted where these foods are grown. Among the various contaminants, lead, cadmium and arsenic are of focal concern given their toxicological significance, even at low concentrations. Thus, the objective of this study was to develop a method for the accurate trace level determination of lead, cadmium and arsenic in food items. A flame atomic absorption spectrophotometry (FAAS) method was developed for the trace level determination of lead, cadmium and arsenic in food items using spice. For this purpose, a good number of instrumental and method parameters were optimized following the international guidelines. The linearity of the method, detection limit, recovery, repeatability, precision and uncertainty for Pb, Cd and As quantification in food items were individually determined and a method validation report has been prepared.

1.3 Preparation of carboxylic acid abundant graphite oxide (GO) and its application in lead (Pb) removal from synthetic waste water

S. B. Quraishi, M. T. Rahman*, A. K. M. A. Ullah, M. M. Hosen and M. S. Hossain*

Graphene has a lot of unique properties and owing to a high surface area, high adsorption capacity is one of them. Modification of graphene has the potential to raise this property significantly. In this work, goal was set to prepare carboxylic acid enriched graphite oxide and check its suitability in Pb (lead) removal from waste water. In suitable steps, a number of batches of carboxylic acid enriched graphite oxide has been developed and characterized. The prepared graphite oxides have been applied to the removal of Pb in 56 samples of synthetic waste water containing different concentration of lead within them and the change in Pb concentration was observed with AAS. The experiments showed significant success and the efficacy of the materials including equilibrium time, pH effect etc. has been determinated.

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1.4 Preparation of Mg-Al layered double hydroxide shielded with graphene oxide and its application in dye removal from synthetic waste water

S. B. Quraishi, M. T. Rahman*, A. K. M. A. Ullah, M. M. Hosen and L. Dhar*

Metal oxides and graphene oxide are both reported to have a potential in dye removal. This work targeted to develop Mg-Al layered double hydroxide shielded with graphene and apply it in dye removal. Using the salt of magnesium and aluminium, a double salt of Mg-Al was formed. This was later interacted with graphene oxide to form Mg-Al layered double hydroxide shielded with graphene oxide. The synthesized material was applied in model dye removal from synthetic waste water.

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1.5 Method development for the determination of trace elements in sea water using ICP-MS

S. B. Quraishi, A. K. M. A. Ullah, M. R. Islam and M. M. Hosen

Due to high salinity, determination of trace elements in sea water using the existing methods and instruments are not much reliable. Hence, the goal of this work was to develop a method for the determination of trace elements at extremely low level using ICP-MS. A suitable method has been established to easily quantify the inorganic trace elements e.g. Pb, Cd, Cr, As, Hg, Sc, Be, U, Th etc. present in saline waters from sea using metal extraction method via metal legand interaction and solvent transfer. After the metals has been transferred to aqueous solvent, they have been identified and quantified using inductively coupled plasma-

Mass spectroscopy (ICP-MS), which is a sensitive tool in inorganic analysis and have traceability upto ppt (part per trillion) level.

1.6 Development of graphene-based adsorbents for removal of heavy metals from tannery effluents

T. R. Choudhury, S. Ahmed*, M. M. Hoseen, M. A. Maksud, S. R. Khan, L. N. Lutfa and S.B Quraishi

Nowadays water bodies across the world are heavily polluted due to uncontrollable contamination of heavy metal particles, toxic dyes and other harmful wastes discharged by emerging industries other than normal domestic wastages. This contamination needs sufficient control to protect the natural water bodies. In this day and age, there is much attraction towards graphene and its oxides, which have widespread range of differential applications in commercial industries because of their eco-friendly characteristic features. Therefore, this research aimed to develop suitable graphene-based adsorbents (graphene oxide and sodium alginate-GO composite) to remove heavy metals from tannery effluents. Graphene oxide was prepared by the oxidation of graphite flakes through modified Hummer method. Prepared graphene oxide was characterized using FT-IR, SEM and elemental analysis method. Adsorption test was carried out at different pH, dose, time and concentration for removal of chromium. It is expected that the developed graphene oxide will bring a drastic revolution in the treatment of tannery effluent in near future. The work is in progress.

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1.7 Chromium (III) removal from synthetic wastewater using biochar produced from vegetable tanned leather shaving dust

T. R. Choudhury, S. Akhtar*, M. M. Hoseen, M. A. Maksud, S. R. Khan, L. N. Lutfa, M.S Rahman, S.B Quraishi and B.A Begum

In recent years, the rapid industrialization leads to increase industrial discharges without any appropriate treatment. This study deals with the removal of Cr (III) ions from aqueous solutions by $ZnCl_2$ treated biochar produced from vegetable tanned leather shaving dust. Effect of various process parameters like solution pH, adsorbent dose, adsorbent type, initial Cr (III) concentration and temperature have been studied in adsorption technique. The thermal resistivity and scanning electron microscopy (SEM) analysis were engaged to perceive the surface morphologies of chemically treated and untreated biochar adsorbent. The experimental data was fitted well to the Langmuir adsorption isotherm model and the adsorption efficiency of chromium (III) was found to be maximum (70%) at low values of pH (around 3) for 0.75 g/50 mL dose of $ZnCl_2$ treated biochar adsorbent. The model matrix of 2^4 full factorial design approach has been applied at a 95% confidence level to find the impact of different variables on removal Cr (III) ions from waste water. This study revealed that three main factors: Adsorbent type ($p< 0.0001$; 66.39%), pH ($p<0.001$; 16.01%) and adsorbent dose ($p = 0.032$; 12.15%) have significant impact on Cr (III) ions removal efficiency. For using $ZnCl_2$ biochar, Cr (III) ions removal efficiency was increased 66.39% compared to using untreated biochar. Subsequently, two interaction factors: pH-time and adsorbent type-time ($\alpha = 0.05$, $p< 0.05$) have shown statistically significant on Cr (III) ions removal efficiency. The $ZnCl_2$ treated biochar adsorbent prepared from vegetable tanned leather shaving dust is efficient and it is proposed that it can be conveniently employed as a low cost alternative in the treatment of industrial waste water.

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Food Chemistry

1.8 A comprehensive analysis of toxic metals and their sources of accumulation by cultured fish, water and sediment in Pagla Sewage Treatment Ponds

S. B. Quraishi, D. Roy*, A. K. M. A. Ullah, M. R. Islam, M. M. Hosen, M. A. Maksud, S. R. Khan, L. N. Lutfa and S. S. Islam*

To determine the level of toxic metals in the flesh of fish cultured in Pagla sewage treatment ponds and consumed by city dwellers and identify their source through the assessment of concentration of heavy metals namely Pb, Cd, Cr, As and Hg in fish, water and sediments. Water, sediment and fish samples were collected from the Pagla sewage treatment ponds and were analysed using AAS technique. The decreasing trend of the trace metals in water was found as Pb>Cr=As=Hg=Cd. All values were within reference limits. The decreasing trend of the trace metals in sediment was Pb>Cr>As>Hg and Cd was found to be below the detection limit. The concentration of Pb and Cr exceeded standard reference value set by USEPA. Among the

ten samples of Tilapia fishes of which were of two age group i.e. small fish of 25 days and big fish of 2 months, heavy metals were found mostly in the small fishes and a few quantity of the big fishes. As and Hg were found below the detection limit. The range ofPbwas0.79± 0.029 mg/kg to 1.12± 0.019 mg/kg in small fishes and 0.09± 0.003 mg/kg to 0.32± 0.02 mg/kg in big fishes. The ranges of Cd was 0.024± 0.002mg/kg to 0.237± 0.004mg/kg in small fishes and below the detection limit in big fishes. Overall, Cr ranged from 0.07± 0.005mg/kg to 0.13± 0.009mg/kg. All these observations suggest that the feeding habit of fish and the habitat they are living in are mainly responsible for metal accumulation.

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1.9 Assessment of heavy metal in pond culture fish, water, sediment and handmade feed at Kapasia, Gazipur

S. B. Quraishi, D. Roy*, T. R. Choudhury, A. K. M. A. Ullah, M. R. Islam, M.M. Hosen, M.A. Maksud, S. R. Khan, L. N. Lutfa and F. Rahman*

The aim of the present study was to evaluate the presence of heavy metals in water, sediment, fish feed and their accumulation in edible fish tissues from pond in order to assess the carcinogenic and non-carcinogenic risk associated with consumption of fish. Three fish feeds, fish (*Oreochromis niloticus*), water and sediment were collected from three aquaculture farms of Kapasia upazila of Gazipur district and heavy metal (Pb, Cd, Hg, As, Cr) concentration were determined by Atomic Absorption Spectrometer (AAS) within them. The results show that the concentrations of heavy metals in water were below the detection limit. The concentration of heavy metals in sediment were below the limit set by USEPA (1999) and the concentration of heavy metals in fish were all below the WHO set values or other standard limits for food safety except for chromium.

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1.10 Heavy metals in liquid milk: Source identification and potential human health risk assessment

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Milk is an ideal food and widely consumed across the country. However, the continual observation of presence of heavy metals in all other food, it is urgent to know about their possible presence in liquid milk and identify their sources. This work intends to quantify the heavy metals (Pb, Cd, Cr, As, Hg, Co, Ni, Mg, Fe, Ca, Zn, Cu) in liquid milk and identify their possible sources. Twenty samples of liquid cow milk have been collected from different sources of supply around the Dhaka city including Savar and Narsingdi area and has been analysed for the presence of the target elements using different form of AAS. Besides, sixteen other liquid milk and their source samples has been collected and will be analyzed.

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1.11 Heavy metal accumulation in meat, liver, kidney of chicken and the potentiality of health risk

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

Chicken is a highly consumed food, particularly in our country. It’s organs like kidney, liver are often preferred over meat considering nutritional value. In this work, target was made to compare the deposition of heavy metals in different body parts of chicken and compare the associated health risks. Different types of chicken viz. native, layer and poultry were collected from local markets of Tangail and analyzed for the deposition of five heavy metals namely Lead (Pb), Cadmium (Cd), Chromium (Cr), Arsenic (As) and Mercury (Hg) in their meat, liver and kidney along with their feed using Atomic Absorption Spectroscopy (AAS). Among the organs, the highest concentration (mg/Kg) of Pb (3.87±0.98) and Cr (1.16±0.35) was found in meat while that of Cd (0. 45±0.09) was in liver and As (0.29±0.06) and Hg (0.08±0.03) were in kidney. Other than for Pb and Cr, the general trend of preferable deposit in soft tissues (liver and kidney) were in accord with reports. Except for mercury, all of these values exceeded maximum permissible limit.

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1.12 Health risk assessment of Bangladeshi consumers to heavy metals via dietary intake of edible oil

S. B. Quraishi, T. Ferdoushy*, A. K. M. A. Ullah, M. N. Alam, M. R. Islam, M. M. Hosen, M. A. Maksud, S. R. Khan, L. N. Lutfa and Maroofa*

To determine the concentrations of heavy metals in edible oils available in the market of Bangladesh and evaluate the associated human health risks to the consumers from their intake. Edible soyabean oil of twenty-one popular brands were collected from market. They were digested via wet digestion technique and analyzed for the presence Pb, Cd, Cr, As and Hg using the AAS technique. In addition to that, the samples were also analyzed for other potential trace elements using ICP-MS technique.

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1.13 Evaluation of Lead and Chromium content in beef collected from five markets of Dhaka city and population health risk assessment

S. B. Quraishi, S. Mamun*, A. K. M. A. Ullah, M. N. Alam, M. R. Islam, M. M. Hosen, M. A. Maksud, S. R. Khan, L. N. Lutfa and M. R. Akanda*

Beef is consumed worldwide as a good source of protein, fat as well as vitamin B, iron, zinc etc. There is a growing evidence that accumulation of heavy metals especially lead (Pb) and chromium (Cr) in beef are growing high. This study was done to estimate the content of Pb and Cr in beef. Fifteen beef samples were collected from five different markets and were analyzed for the presence of Pb and Cr in them. The concentratrion of Pb varied between 0.063 ± 0.009 to 0.845 ± 0.127 mg/Kg and the concentration of Cr varied between 0.05 ± 0.007 to 0.121 ± 0.018 mg/Kg. Except for Cr in beef of one market, all values were high compared to recommended value set by relevant standard bodies.

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1.14 Toxicological risk assessment of lead, cadmium and chromium in tobacco leaf and smokeless tobacco products available in Bangladesh

A. K. M. A. Ullah, M. M. Hosen, S. R. Khan, M. A. Maksud, L. N. Lutfa and S. B. Quraishi

The *Nicotiana tabacum* (tobacco plant) is widely known for its leaves that are used as smoking, chewing or snuffing for various effects. The addiction of tobacco originates from its main constituent nicotine. About 4,000 chemical substances as potential carcinogens have been identified in tobacco products by the International Agency for Research on Cancer (IARC). This includes toxic substances such as tobacco specific nitrosoamines (TSNAs) specially 4-(*N*-nitrosomethylamino)-1-(3-pyridyl)-1-butanone (NNK) and *N*-nitrosonornicotine (NNN), inorganic ions such as nitrate and nitrite as well as heavy metals such as cadmium (Cd), chromium (Cr), nickel (Ni) and lead (Pb). The present study was aimed to evaluate the toxicological risk assessment of lead, cadmium and chromium in tobacco leaf and smokeless tobacco products available in Bangladesh. In the present study, concentrations of three carcinogenic heavy metals namely-lead (Pb), cadmium (Cd) and chromium (Cr) were estimated in 72 tobacco leaf and smokeless tobacco products (Zarda and Gul) available in Bangladesh using flame atomic absorption spectrophotometric (FAAS) technique and the lifetime cancer risk was calculated from the exposure of Pb, Cd and Cr. The results demonstrated that the samples contain higher levels of Pb, Cd and Cr compared to GOTHIATEK standard. The calculated overall cancer risk indicated that about 95% of the investigated samples exceeded the U.S. Environ. Protection Agency (USEPA) benchmark of acceptable range of 10E-6 to 10E-04.

1.15 Potential Concentration, source identification and potential human health risk assessment of heavy metals in chicken meat and egg in Bangladesh

A. K. M. A. Ullah, S. Afrin*, M. M. Hosen, T. Ferdoushy* and S. B. Quraishi

All around the world, chicken meat and their egg-based foodstuffs are very popular as a non-piscine protein source and widely consumed as curry, fast food, processed food, etc. The constantly rising anthropogenic and industrial pollutions stresses on the necessity of continuous monitoring of the presence of heavy metals in food samples. Thus, a study has been carried out in order to measure the concentration of eight heavy metals in three most commonly consumed varieties of chicken meat and three varieties of hen egg in Bangladesh, identification of their probable sources and assess the associated carcinogenic and non-carcinogenic risks

from their intake. The results demonstrated that among the studied metals only the mean concentration of Pb exceeded the maximum allowable concentration (MAC) for dietary food. Multivariate statistical analyses depicted that anthropogenic activities were the major source of toxic heavy metals in the investigated foodstuffs. Human health risks associated with the dietary intake of these metals through the consumption of chicken meat and hen egg were evaluated in terms of estimated daily intake (EDI), non-carcinogenic risk of individual heavy metal by target hazard quotient (THQ), total target hazard quotient (TTHQ) for combined metals and carcinogenic risk (CR) for lifetime exposure. The calculated values of EDI, THQ, TTHQ and CR were below their respective permissible benchmarks indicating the safe consumption of the investigated foodstuffs with respect to heavy metal contamination.

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1.16 Quantification, source apportionment and human health risk assessment of toxic metals in fishes collected from south central coastal region in Bangladesh

T. R. Choudhury, T. Islam*, M. M. Hoseen, M. A. Maksud, S. R. Khan, L. N. Lutfa and S.B Quraishi

Heavy metals are a global concern, due to their potential toxic effect and ability to bioaccumulate in aquatic ecosystems, which might have a negative impact on human health through consumption of fish. The purpose of the study was to assess the health risks due to metal exposure from consuming various fish species in the island of Bhola, the south central region of Bangladesh. The heavy metal concentrations in edible part (flesh) of ten cultured fish samples were evaluated with validated and accredited methods using Atomic Absorption Spectrophotometer (AAS) and appraised human health risk through consumption of these highly consumed and commercially important fishes. Mean concentrations (mg/kg) of decendending order were Fe>Zn> Cu>Co>Mn>Ni>Pb>Hg>As>Cr>Cd observed in fish species. The As, Cd and Cr levels in all samples were found below the detection limit of our laboratory developed method. The health risk assessment was evaluated by calculating metal pollution Index (MPI), daily intake (EDI), target hazard quotient (THQ) and total target hazard quotient (TTHQ) using the FAO/WHO and USEPA recommendations. Based on our results, the EDI, THQ as well as TTHQ values for all of elements in fish samples were lower than 1, which indicated there was no possible health risk to consumers due to intake of studied metals in fishes under the current consumption rate. On the other hand, the target cancer risk (CR) esteem for poisonous inorganic Pb, Cd, Cr and As were below 10^{-6}, demonstrating no cancer-causing chance through consumption of fishes presently. Pearson's correlation showed both of significant positive and negative correlations between the heavy metal concentrations in fish species. Principal component analysis (PCA) and Cluster analysis (CA) were employed to reveal the possible sources (natural and anthropogenic) which might be contaminated fishes in future

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1.17 Assessment of impurities associated human health risks of locally available black salts from Dhaka City, Bangladesh

T. R. Choudhury, K. J. Fatema, K. Islam*, M. M. Hoseen, M. A. Maksud, S. R. Khan, L. N. Lutfa, S.B Quraishi and B. A. Begum

Black salt is considered as one of the most vital food additives to increase the taste of foods. Currently, about 5% of the total black salt extracted in the world is destined only for human consumption. Investigation of impurities in black salt is very important to evaluate the quality of consumer black salts. The objective of the study was to investigate the human health risks associated with fluoride (dental Fluorosis) and heavy metals consumption in black salts. The samples were collected from different street food shops, groceries and restaurants at Dhaka city. Major impurities of consumer black salts such as anions (F^-, NO_2^-, SO_4^{2-}, NO_3^- and $PO4^{3-}$) and cations (NH_4^+, K^+, Mg^{2+} and Ca^{2+}) in black salt samples were examined by using Ion Chromatography (IC) system. Atomic Absorption Spectrophotometry (AAS) has been used to determine the heavy metals (Fe, Pb, Cu, Cr, As and Hg) concentration in black salt samples. The metallic constituent's concentration was higher than that of the BSTI standard and other international standards of consumer black salts limit. In addition, mean Hazard Quotient (HQ) and Hazard Index (HI) values based on Fe, Pb, Cu, Cr, Hg and As implicit that the black salt poses substantial health risk for adults. The carcinogenic risk for adults due to As, Pb and Cr is very high. The estimated daily intakes (EDIs) of the heavy metals were higher than

the tolerable daily limits. The health risk assessment indicated that the consumption of these salts has potential health risk and are therefore is not safe for humans. From the present investigation, it can be concluded that studied different consumer black salts of Bangladesh contained greatest content of impurities. Consuming these salts may lead to serious health hazards to the consumers.

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1.18 Assessment of heavy metals in fishes of Dhaka City's fish market and its possible health risk

Y. N. Jolly, M. S. Rahman, S. Akhter, J. Kabir, K. M. Mamun, M. Hasan and B. A. Begum

Five varieties of commonly consumed fish samples (locally named Katla, Ruhi, Ilish, Pangash, Telipia) have been collected from different fish markets of Dhaka city and analysed for heavy metal content (Fe, Se, Rb, Cr, Cu, Pb, Zn, As and Hg) using Energy Dispersive X-ray Fluorescence (EDXRF) Spectroscopy. Different organs of fish sample like flesh, bone, skin and gill were studied and compare with International standards. Possible Health Risk due to dietary intake of this contaminated fishes also calculated. Among the five fish species, higher concentrations of Zn, Fe, Cu, Se, Rb, Pb and As were found in P. Pangasius, L. Rohita and T.Ilisha. Pb and As concentrations in fish muscle exceeded the international safe limits.

1.19 Trace metals in Fish samples collected from Halda River and their health risk assessment

Y. N. Jolly, M. S. Rahman, S. Akhter, J. Kabir, K. M. Mamun, M. Hasan and B. A. Begum

Description: A total of six species of fish namely: of Rohi, Katla, spotfin swamp barb, molacarplet, Goby and climbing perch investigated for heavy metals. All varieties of samples showed the level of As, Cr, Mn, Co, Ni below their detection limit of EDXRF (As: 0.41, Cr: 0.41, Mn: 0.31, Co: 0.28, Ni: 0.24) in mg/kg respectively. The concentrations of the elements- Ca, Fe, Cu, Zn, Hg and Pb in all varieties of fishes varied from 138.18-336.28, 52.07-870.84, 17.18126.412, 48.25-115.54, 0.39-2.11, 0.23-0.51mg/kg respectively. Among different fish samples. Metal Pollution Index (MPI) as shown in Fig. followed a decreasing sequence of Molacarplet (19.87)>Katla (18.93)>Goby (18.04)>Climbing perch (16.71)>Spotfin swamp barb (15.63)> Rohu (13.27). The result showed that the health risk index (HRI) for Hg, Pb, Cu, Zn, Fe and Se in all types of fish samples are lower than 1.

1.20 Dietary intake of heavy metal due to consumption of fishes of Buriganga river of Bangladesh and possible health risk assessment

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

Description: A total of 10 Fish samples were collected from the Buriganga River and analysed for heavy metal (Ca, Cr, Mn, Cu, Zn, As, Se, Fe, Se, Sr, Hg and Pb) concentration using EDXRF technique and found lower than the safe value recommended by WHO Standard 2004, FAO/WHO 1989, US FDA 1993 except Iron, Copper, Zinc and Mercury. The metal pollution index, for all sample of fishes are quite high. The health risk index (HRI) value, through the consumption of fish was less than 1 except Mercury in Kholshe and Copper in Tengra fish, indicating that there is no potential significant health risk associated with consumption of fishes other than Kholshe and Tengra. From the human health point of view, the THQ values for individual element were lower than 1, suggesting that there was no health risk.

1.21 Potential human health risk s of poultry chicken

Y. N. Jolly, M. S. Rahman, S. Akhter, J. Kabir, K. M. Mamun and M. Hasan

Description: A total of 10 chicken, 10 water and 5 feed samples were collected from different farms of Savar, Bangladesh and analysed for heavy metals (Ca, Mn, Cu, Co, Ni, Fe, Zn, As, Se, Gr, Rb, Sr, Hg and Pb) using EDXRF. This study showed that the Estimated Daily Intake of Ca and Fe arte higher than the maximum tolerable limit for people.

1.22 Phytochemical analysis of Ocimum tenuiflorum (Tulsi leaf) using GC-MS technique

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

Tulsi (Ocimum tenuiflorum) is an aromatic perennial plant in the family Lamiaceae. It is available in the Indian Subcontinent and a widespread cultivated plant. This plant is usually cultivated for religious purpose, a precursor of traditional medicine, herbal tea and a source of essential oil. Thus, it has remarkable medicinal and economical importance. Hence, it is crucial to evaluate the phytochemical compositions present in the

Tulsi. Considering this importance, a study Program has been conducted to find out the presence of phytochemicals in Tulsi leaf. Gas chromatography-Mass spectroscopy (GC-MS) technique was employed in order to identify and quantify them.GC-MS analysis of the pre-concentrated extract showed the presence of 45 phytochemicals constituting more than 80% of the total compounds. The observed phytochemicals and their proportions were found to be: alkane (17.82%), carotenoid (7.56%), terpine (1.64%), isoprene (24.1%), steroid (3.45%), alkaliod (13.7%), alchoholic (1.03%) and antioxidant (12.7%). The major compounds β-Caryophyllene, β-Caryophyllene Oxide, Imidazolidedione, Cephalotaxine, Dipyridamole, Canthaxanthin, alpha- Lumicolchicine, etc. were notable. β-Caryophyllene and β-Caryophyllene Oxide (Terpinoid) compounds act as anti-fungus, anti-inflammatory and anti-cancer.

1.23 Chemical compositions of the methanoic extract of *Azadirachta indica (*neem) leaf using gas chromatography-mass spectrometry technique

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

Azadirachta indica, commonly known as neem, nimtree or indian lilac, is an important medicinal plant of the Meliaceae family. The aim of the present study is to investigate the phytochemical analysis of methanoic extract of Azadirachta indica (neem) leaf for feasibility study of raw materials production in medication purposes. The sample was collected, washed and dried in oven over at 60°C, then it was crushed for homogenization. After crushing about 10g sample was taken into 100 mL methanol and refluxed for 48 hours at 60°C.The methanoic extracted were pre-concentrated to 1-2 mL by using nitrogen gas evaporator. Gas Chromatography-Mass Spectrometry Technique ere applied for the analysis of phytochemicals in the methanoic extract of Neem leaf. There are fifty two organic compound were identified. The study shows that Neem leaf (Azadirachta indica) contain different types of phytochemical compounds which considered to be benifitial for human race such as 3,5,24-trimethyl-Tetracontane (15.42%), Caryophyllene (5.11 %), Copaene (4.06%), 3,3',4,4'-tetradehydro-1,1',2,2'-tetrahydro-1-hydroxy-1'-methoxy-psi,psi.-Carotene (3.35%), Cyclic 1,2-ethanediyl aetal, (5.beta.)-Cholestan-3-one (2.49%), Canthaxanthin (2.16%), 9-Desoxo-9-xi-hydroxy-3,7,8,9,12-pentaacetate ingol (2.05%), Demecolcine (0.95%), Tritetracontane (0.86%) etc.

1.24 Phytoconstituents investigation by GC-MS of *Cynodon dactylon* (Durba ghas)

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

Cynodon dactylon contains many metabolites notably proteins, carbohydrates, minerals, flavonoids, carotenoids, alkaloids and glycosides. The plants are used as appetizer, tonic, analgesic, anti-diarrheal, anti-inflammatory, anti-bacterial and antidiabetic. This study provides a comprehensive detail of the phytoconstituents of Cynodon dactylon. Phytoconstituents of Cynodon dactylon (Durba gras) were identified by Gas chromatography-Mass spectroscopy (GC-MS). GC-MS analysis of the pre-concentrated extract showed the presence of 60 Phytchemicals constituting more than 80% of the total compounds. The observed major Phytochemicals were found to be: 10-methoxy- Akuammilan-17-ol (8.14), ((1E)-3-Hydroxy-1-propenyl)-2-methoxyphenol (7.57%), 1-(2,4,6-trihydroxyphenyl)- 2-Pentanone (6.22%), 2,6-Difluorobenzoic acid, 4-cyanophenyl ester (5.49%), 2-Methoxy-4-vinylphenol (5.01%), Acetic acid, 2-(2,2,6-trimethyl-7-oxa-bicyclo[4.1.0]hept-1-yl)-propenyl ester (3.27%), (Z,Z,Z)-9,12,15-Octadecatrienoic acid, 2,3-dihydroxypropyl ester (2.68%),1-Methyl-4-amino-4,5(1H)-dihydro-1,2,4-triazole-5-one (2.17), 3',5'-Dimethoxyacetophenone (1.95%), 2,3-Anhydro-d-galactosan (1.89%), Mequinol (0.63%) etc.

Atmospheric and Environmental Chemistry

1.25 Investigation of heavy metal concentration of sea water in the North Eastern part of the Bay of Bengal

S. B. Quraishi, A. Islam*, T. R. Choudhury, A. K. M. A. Ullah, M. M. Hosen, M. A. Maksud, S. R. Khan, L. N. Lutfa and D. Das*

To evaluate the quality of sea water in relevant to the public health by the measurement of water quality parameters and the determination of the level of heavy metals in the estuarine and marine water of the Bay of Bengal This study conducted the measurement of the concentration of five heavy metals e.g. Pb, Cd, Cr, As and Hg in sea surface water collected from seven location from the Bay of Bengal and Five location near to the Hatiya coastal upazila by the Graphite Furnace and Atomic Absorption Spectrometer technique. The average decreasing order of the metals were as Pb>Cr>Hg>Cd with the value 0.109, 0.2, 0.011, 0.0467, 0.003

mg/L respectively. Some of the values exceed USEPA limits indicating that the degree of heavy metal contamination falls in the unpolluted to slightly polluted class.

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1.26 Assessment of groundwater chemical composition and their characteristics: a case study of Chandpur district

A. K. M. A. Ullah, F. Siddique*, M. M. Hosen, M. A. Salam* and S. B. Quraishi

Groundwater is the main sources of freshwater for drinking water and irrigational water supply at Chandpur districts. Over 10,000 people have been identified to be affected by arsenic poisoning in Chandpur districts in 2013. The health hazard due to this contamination has raised the serious concern for public health. Other potential toxic explosion from current groundwater trace elements concentration is still hidden in the study area. In this point of view, our main objective is assessment of chemical composition and their characteristics in deep water, shallow water and river water. The trace metal Li, Be, B, Sc, V, Cr, Co, Ni, Cu, Zn, Ga, Cd, Pb, Hg, Bi, Th and U were found within the permissible limit. But Fe, Mn, As and Ba were found beyond permissible limit. Cations and anions of groundwater were used to estimate the characteristics and origin of groundwater. The Piper diagram showed that the types of the groundwater were of Na^+-Cl^--NO_3^- and Na^++HCO_3^-. The deep water (DW) was dominated by silicate weathering. The quality of agricultural water was evaluated using SAR, sodium (%), RSC, PI, SSP, MH, PS and Kelly's ratio and was classified as SAR DW (excellent 100), SAR SW (excellent 95.65 and good 4.35), SAR RW (excellent 100%), sodium% DW (excellent 8.33%, good 37.5% and permissible 33.33%), Sodium% SW (excellent 13%, good 37%, permissible 17%, doubtful 19.5%, an unsuitable 13.04%), RSC DW (good 66.67%, medium 22.22% and bad 11.11%), RSC SW (good 33.33% and bad 66.67%), MH DW (acceptable 25% and non-acceptable 75%), MH SW (acceptable 50% and non-acceptable 50%) and MH RW (acceptable 56% and non-acceptable 44%).

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1.27 Comprehensive assessment of trace metals in water, sediment and fish species from the Padma river, Bangladesh

S. B. Quraishi, T. R. Choudhury, A. K. M. A. Ullah, M. N. Alam, M. R. Islam, M. M. Hosen, M. A. Maksud, S. R. Khan, L. N. Lutfa and J. Tajri*

Padma is the longest river of Bangladesh and it is suspected that with time, its extent of pollution is rising. The current work was adopted to analyze the quality of fish, water and sediments from Padma river in terms of trace metal contamination. Under this project, along with fishes of different sizes and species, twenty-one water and sediment samples has been collected from time to time from 7 different location along the Padma river. The samples are under preparation for analyzing the presence of trace metals including Pb, Cd, Cr, As and Hg. It is expected that the study will reveal the pollution status of the river as well as will help to suggest necessary actions needed in this regard in future.

*****Dept. of Fisheries, University of Dhaka.

1.28 Analysis of soil, water and sediment under the project 'Assessment for selecting suitable place for the construction of Nuclear Power Plant in southern Bangladesh'

S. B. Quraishi, A. K. M. A. Ullah, M. N. Alam, M. R. Islam and M. M. Hosen

To find out the quality of soil, water and sediment of probable places for NPP construction in terms of inorganic elements and establish a baseline data for future use. Under this project, in the first phase, twenty-seven soil, twenty-eight water and nine sediment samples has been collected from three places of Barguna district and in the second phase, eighteen soil, eighteen water and six sediment samples has been collected from Patualhali district of Bangladesh. The samples are under preparation for future analysis.

1.29 Hydro-chemical investigation of groundwater quality and associated human health risks appraisal in the southwestern region of Bangladesh

T. R. Choudhury, K. J. Fatema, N. Hossain*, M. M. Hosen, M. A. Maksud, S. R. Khan, L. N. Lutfa and S. B. Quraishi

The objective of the study was to investigate the hydro-chemical characterization, water quality evaluation in terms of drinking and irrigation purposes and possible consumptive human health risks associated with

groundwater quality of Jessore, the southwestern region in Bangladesh and to examine by integrated approach; a set of hydro-chemical analysis, water evaluation indices, heavy metal pollution indices and multivariate statistical techniques. Total 30 groundwater samples were analyzed for the intended purposes. The concentration of major cations (Li^+, Na^+, NH_4^+, K^+, Mg^{2+} and Ca^{2+}) and anions (F^-, Cl^-, NO_2^-, SO_4^{2-}, NO_3^- and PO_4^{2-}) were determined by Ion Chromatography (IC) system and the concentration of heavy metals (Fe, As, Zn, Mn, Cu, Pb, Co, Cr, Cd, Ni and Hg) has been analyzed using Atomic Absorption Spectrophotometer (AAS). From the present study, it was found that some of the studied hydro chemical parameters (As, Mn and Pb) exceeded the limits stipulated by different national and international standards for drinking water. Principal component analysis (PCA) results revealed that the natural geogenic sources (Rock-water interaction (weathering) in aquifers, dissolution minerals and cation-anion exchange) were the major factors influencing the groundwater quality of the study area. Furthermore, the results of PCA are validated using the cluster analysis (CA) and correlation matrix (CM) analysis. Based on the groundwater quality index (GWQI), it is found that all the groundwater samples belong to poor quality for drinking as 66% of the samples exceeded the permissible GWQI limit. The results of irrigation water quality index including sodium adsorption ratio (SAR), magnesium absorption ratio (MAR), total hardness (TH), Kelly's ratio (KR), residual sodium carbonate (RSC), permeability index (PI) and sodium percentage (Na %) suggested that salinity hazard may affect the irrigation activities. In addition, mean Hazard Quotient (HQ) and Hazard Index (HI) values based on Fe, Mn, Cr, As, Cd, Zn, Cu and Pb imply that the groundwater poses substantial health risks for both adults and children. The carcinogenic risk among adults and children due to As and Pb is very high and high, respectively in the study area. Thus, considering all the above findings, it can be concluded that groundwater quality of Jessore Sadar Upazila is moderately suitable for both drinking and irrigation purposes and the groundwater of the study area was characterized by high level of non-carcinogenic as well as cancer-risk (As and Pb) vulnerability of the local community.

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1.30 Evaluation of some metals accumulated in animal diversity of Cox's Bazar and Teknaf in Bangladesh and histo-pathological evidences in the brain

T. R. Choudhury, K. F. Siddika*, M. M. Hosen, M. A. Maksud, S. R. Khan, L. N. Lutfa and S. B. Quraishi

Heavy metals exert their toxic effects through different mechanisms. Lately, increasing attention has been focused on understanding the long-term ecological effects of chronically exposed populations and communities and their consequences to the ecosystem. The long-term exposure to heavy metals in the environment represents a threat to animal populations, affecting communities and putting ecosystem integrity at risk. Therefore, the objective of the study was to assess a threat to biodiversity due to exposure of heavy metals and also the histopthological lesions in the coastal areas (Cox's Bazar and Teknaf) in Bangladesh. The accumulation of metals such as arsenic (As), cadmium (Cd), chromium (Cr), copper (Cu), mercury (Hg), nickel (Ni), lead (Pb) and zinc (Zn) from the samples of insects **(**viz. *Periplaneta americana* and *Chrysomya megacephala*), malacostracan *(Penaeus monodon*), fishes *(Lutjanus johnii and Rastrelliger kanagurta,)* and domesticated chicken (*Gallus gallus domesticus*) were evaluated in the two areas named Cox's Bazar and Teknaf. The detection of the metals was performed using flame, hydride-generation and graphite furnace Atomic Absorption Spectrophotometer. Concentrations of Cd, Cr, Cu, Ni, Pb and Zn were generally higher in all samples than As and Hg. Most of the values of As and Hg were below the detection limits except As in *P. americana, C. megacephala, P. monodon* and Hg in *P. americana, P. monodon, Rastrelliger kanagurta.* The tissues from insects **(***P .americana*), fishes (*L. johnii* and *R. kanagurta,*) and domesticated chicken (*G. gallus domesticus*) were used to prepare histo-pathological slides. Histo-pathological observation revealed that deposition of metals, vacuolization, neural aggregation and tissue degeneration were observed in the brain tissue of insects and vertebrate (fish and chicken). The levels of heavy metals were compared with standards of WHO and FAO. All the values except As and Hg were higher than the WHO and FAO recommended values. Pearson's correlation matrix analyses were done to correlate the values of quantified metals for all the samples collected from two areas. Dendrograms of cluster analysis reveal that these metals are interrelated with each other and might have originated from the similar sources.

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1.31 Health Risk assessment of toxic heavy metals in dust particles of different schools in Dhaka city, Bangladesh

M. S. Rahman, S. Akter, M. J. Kabir, B. A. Begum and Y. N. Jolly

Heavy metals, such as Pb, Cu, Mn, Zn, Cd, Ni, Cr which are found in street dust, have significant impact for Environ. pollution. Elemental analysis in street dust was carried out using of X-ray fluoroscopy spectrometry (XRF) method. The average concentration of the studied elements are Ca (63988.82 mg/kg), Fe (23524.12 mg/kg), Ti (2484.87 mg/kg), Zn (439.68 mg/kg), Sr (264.37 mg/kg), Zr (150.74 mg/kg), Cr (109.97 mg/kg), Rb (92.7 8 mg/kg), Cu (77.99 mg/kg), Pb (40.86 mg/kg), Ni (30.15 mg/kg) and As (21.60 mg/kg). Due to the rapid growth of population, heavy traffic and improper management are the main causes of high level concentration of heavy metals in the dust particle in Dhaka City.

1.32 Understanding the fog water composition and sources at an island location (Bhola, Bangladesh)

M. S. Rahman, Y. N. Jolly, K. J. Fatem and T. R. Choudhury

A comprehensive study on the chemical composition and source characterization of fog water was subjected to carry out at an outflow location of the Indo-gangetic plain to the Bay of Bengal (Bhola-Bangladesh) during winter season. To measure ther source contribution and air mass trajectory analysis, the average pH, EC, TDS, TOC of the collected fog water samples were 7.03±0.2, 371.2±63 µS cm^{-1}, 235.8±128 ppm and 15.8±5.8 ppm, respectively. The average concentration of F^-, Cl^-, SO_4^{2-}, NO_3^-, HCO_3^-, Na^+, K^+, NH_4^+, Ca^{2+} and Mg^{2+} were 77.7±38.5, 937±416.5, 725.24±383.9, 1002.4±562.2, 70±48.2, 733.8±205.3, 338.6±188.7, 562.5±402.9, 1147.4±616.2, 350±125.5 µeqL^{-1}, respectively.

1.33 Heavy metals contamination in sediment of Meghna river, Bangladesh

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

Globally alarming toxic heavy metals (i.e., Zn, Pb, Cu, physical properties of fog water including color, odor, pH, Electrical Conductivity (EC), total dissolve solid (TDS), total organic carbon (TOC) were targeted to measure for source contribution calculation and air mass trajectory analysis. This study revealed that the average pH, EC, TDS, TOC of the collected fog water samples were 7.03±0.2, 371.2±63 µS cm^{-1}, 235.8±128 ppm and 15.8±5.8 ppm, respectively. The average concentration of F^-, Cl^-, SO_4^{2-}, NO_3^-, HCO_3^-, Na^+, K^+, NH_4^+, Ca^{2+} and Mg^{2+} were 77.7±38.5, 937±Ni, Fe, Mn, Cr, As) concentrations are targeted to estimate in sediment samples of the Meghna River in Bangladesh using Energy Dispersive X-ray Fluorescence (EDXRF). Result of this study showed thatthe average concentration of the studied metals showed the following trend: Ca>K>Fe>Ti>Sr>Zr>Pb>Cu>Mn>Zn>Ni>As>Cr. Spatial distribution and severity of sediment-associated contamination by heavy metals based on the newly developed indices ($mPEL_Q$ and $mERM_Q$) were in good agreement with existing pollution indices. Potential contamination index (PCI) generally followed the sequence Sr>Pb>Fe>K>Zn>Ti>Zr>Ca>Cr. I_{geo} values showed that sediments are strongly contaminated with Ti and Pb and also moderately contaminated with As.

1.34 Contamination and ecological risk assessment of heavy metal in soils around the export processing zone, Ishwardi, Pabna, Bangladesh

M. S. Rahman, T. R. Choudhury, M. Hasan, M. A. M. Sarkar, Y. N. Jolly, S. Akhter, J. Kabir and B. A. Begum

The soil samples were collected from twenty points randomly in the study area. Elemental concentration in the collected soil samples were analyzed by X- ray fluorescence (XRF) analytical method at atomic energy centre, Dhaka. The research found that the soils under study had low levels of essential metals V, Cr, Mn, Co, Ni, Cu, Ti and Zn, while they had higher levels of Y, Zr, Pb, K, Ca, Rb, Sr and As concentrations in the soil samples. Several Environ. contamination monitoring parameters, viz. the level of enrichment factor (EF), contamination factor (CF), degree of contamination (Cd), geoaccumulation index (Igeo) and modified degree of contamination (mCd) indicates ‘low’ degree of contamination. Pollution load indices (PLI) of the studied area are lower than unity, indicates no pollution.

1.35 Metal concentration in salt marsh sediments and macrophytes from Bangladesh coastal area

Y. N. Jolly, M. S. Rahman, S. Akhter, J. Kabir, K. M. Mamun and M. Hasan

This research was done to investigate the metal concentrations in salt marsh sediments andmacrophytes from Bangladesh coastal area using EDXRF (Energy Dispersive X-ray Fluorescence) Spectroscopy. Sediment

samples and macrophytes were collected from six salt marsh habitats from Bangladesh coastal area in Jan. 2018. Metal content in soil samples for Pb, Zr, Sr, Rb, As, Zn, Cu, Ni, Fe, Cr, Ti, Ca, K ranged from 1.35-10.42, 96.21-161.35, 138.32-209.64, 124-186.57, <4.17, 37.71-44.95, 36.51-51.66,<0.19, 25020-35177, <5.18 ,2678-3341, 8679-16323, 23680-16770 mg/kg respectively. Contamination factors in the sediment followed the order of $S_9>S_6>S_{11}>S_7>S_2>S_{13}>S_{15}>S_{18}>S_5>S_4>S_{11}>S_8>S_{16}>S_3>S_1>S_{14}>S_{17}$. Geo-accumulation Index in the sediment of the eastern coast site can be treated as unpolluted to moderately polluted with Cu, Zn, Rb, Sr, Zr and Pb but practically unpolluted with Cr, Ni, As, Fe, K, Ca and Ti.

1.36 Assessment of sediment samples collected from halda river, Bangladesh

Y. N. Jolly, M. S. Rahman, S. Akhter, J. Kabir, K. M. Mamun, M. Hasan and B. A. Begum

To study the compositional trends of heavy metals as well as the sediment response towards the untreated chemical wastes received by HaldaRiver, Bangladesh using energy dispersive X-ray fluorescence (EDXRF). All the elements (K, Ca, Ti, Cr, Fe, Ni, Cu, Zn, As, Rb, Sr, Zr, Eu, Pb) showed their range within the acceptable limit of UCC except for the Rb. The calculated pollution load index (PLI) of sediments of the studied region varied from site to site which ranged from 0.68-0.87. All the sampling sites showed value below 1 and by implying the classification, all of the sampling stations fall under no pollution level category. The value ofIgeo for all the sediment samples range from 7 to -1.15. No significant pollution was found in sediment sample

1.37 Human health risk assessment of heavy metals in soil from the proposed site of Ruppur Nuclear Power Plant (RNPP), Bangladesh

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

Soil samples were collected at depth of 5-9 inch in fifthteen station around RNPP. The concentration of Pb, Cu, Zn and As were determine in the soil samples range from 61-863, 11-47, 93-165 and 7-12 mg/kg respectively. The concentration of Cr and Co are not found. The concentration of heavy metals in the soil display the following decreasing trend: Pb>Zn>Cu>As. The study proved that soil contamination in RNPP is not insignificant; risk assessment indicated that the carcinogenic risk is completely insignificant but the cumulative non-carcinogenic risk tends to became significant, mainly for children, since it approaches unacceptable values. There is no particularly dangerous single heavy metal, but their cumulative effect, expressed as Child Soil Ingestion Hazardous Index, is for concern.

1.38 Sources, factors, impacts and possible solutions to pollutants in the coastal region of Chittagong

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

Ship breaking creates a large amount of toxic chemicals, which are dumped into the coastal water. Thus the most diverse aquatic condition is spoiled continuously. So, to gather some idea about the coastal area and to find a possible solution this research work was done. Sediment and plant samples collected from ship breaking yard were analyzed to detect the level of heavy metal concentration and to evaluate their potential ecological risk. Deadly metals like Cr, Cu, As, Zn, Pb, Zr were tested by usingEpsilon 5 EDXRF Spectrometer System at Bangladesh Atomic Energy Commission (BAEC) chemistry division. The study result displayed the rate of pollution from heavy metals decreases in following order: Zr>Zn>Sr>Pb>Cu>Cr>As. Future progress will be reported in time.

1.39 Present status of heavy metals contamination in the soil of tannery village, Bangladesh

M. S. Rahman, T. R. Choudhury, M. Hasan, M. A. M. Sarkar, S. Akther, M. J. Kabir and Y. N. Jolly

This thesis will help to reckon the contamination in industrial area and may pave the way to overcome it. Globally alarming heavy metal (i.e., Zn, Pb, Cu, Ni, Fe, Mn, Cr, As) concentrations were estimated in soil of tannery village in Bangladesh. Heavy metals were analyzed by Energy Dispersive X-ray Fluorescence (EDXRF). The results were used to assess the degree of contamination and estimate the extent of anthropogenic inputs from tannery industrial activities. Result showed that the average concentration of the studied metals showed the following order: Ca>Co>Ti>Fe>Cr>Mn>Sr>Zr>Rb>Zn>Cu>Ni>Pb>As. Enrichment factor (EF), Pollution Load index (PLI), geo-accumulation index (Igeo), contamination factor (C_f), degree of contamination (C_d), Modified degree of contamination (mC_d) were used to evaluate the heavy metal contamination in soil. Most the values of degree of contamination indicated considerable contamination and the values of Modified degree of contamination indicated high contamination. On the other hand, values

of Pollution Load index (PLI) indicated within the range of moderately to very highly polluted and enrichment factor (EF) is very low. Furthermore, a toxic-response factor is applied to assess the potential ecological risk of these heavy metals into the soil.

1.40 Sources, factors, impacts and possible solutions to pollutants in the coastal region of Chittagong

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

Ship breaking creates a large amount of toxic chemicals, which are dumped into the coastal water. Thus the most diverse aquatic condition is spoiled continuously. So, to gather some idea about the coastal area and to find a possible solution this research work was done. Sediment and plant samples collected from ship breaking yard were analyzed to detect the level of heavy metal concentration and to evaluate their potential ecological risk. Deadly metals like Cr, Cu, As, Zn, Pb, Zr were tested by using Epsilon 5 EDXRF Spectrometer System at Bangladesh Atomic Energy Commission (BAEC) chemistry division. The study result displayed the rate of pollution from heavy metals decreases in following order: Zr>Zn>Sr>Pb>Cu>Cr>As. Future progress will be reported in time.

1.41 Chemical characterization of water quality for drinking and agricultural purposes: A case study Ishwardi, Pabna, Bangladesh

M. S. Rahman, K. J. Fatema, T. R. Choudhury and B. A. Begum

Water samples were collected from the preselected 20 sampling points. The study reveals that pH, EC, TDS, Salinity, Na^{+}, Ca^{2+}, K^{+}, Mg^{2+}, Cl^{-}, NO_3^{-}, SO_4^{2-}, PO_4^{3-} values of water in tolerable limit according Bangladesh and international standards. This study also shows the heavy metal such as Cr, Fe, Ni, Cu, Zn, Pb and Cd are remaining in trace amount in the study area. The heavy metal pollution index (HPI), degree of contamination (*C*d), heavy metal evaluation index (HEI) reveal that all of the well water samples belong to good quality condition for drinking purpose. However, *C*d provide better alternative than other indices.

1.42 Elemental distribution of soil samples in the area of a fertilizer factory and assessment of its contamination level

S. Akter, M. O. Rahman, K. M. Mamun, M. Hasan, M. Sarker, M. J. Kabir, M. S. Rahman, B. A. Begum, M. J. Abedin, S. I. Tushar, N. Sultana and Y. N. Jolly

Twenty Soil Samples were collected from different points of Jamuna Fertilizer area which are found in soil sample have significant impact for Environ. pollution. The average concentrations of heavy metals K, Ca, Mg, Ti, Fe, Co, Cu, As, Zn, Rb, Sr, Zr, Pb and Th are 11828, 8607, 14711, 4378, 47358 10.93, 17.04, 8.65, 191, 191, 264, 88.69 and 17.55 mg/kg respectively in soils .In most cases, the mean concentrations of the heavy metals exceed the permissible limit of world average value. Significantly higher concentrations of Mg, Fe, Co, Cu, Zn, As, Rb, Sr, Pb and Th were found in soil samples. The heavy metals contaminations in the soils were also evaluated by applying index of geo-accumulation (Igeo), enrichment factor (EF), contamination factor (CF), degree of contamination (Cd) and pollution load index (PLI) etc. The present reveals the sampling site are highly contaminated by Zn and considerable contamination Mg and Pb while moderately contaminated by Fe, Co, Cu, Rb, Sr, As, Rb, Y and Th. This study revealed that mean EF values of K, Ca, Ti, Fe, Co, Cu, Zn, As Rb, Sr, Y, Zr and Pb followed the increasing order of Ca(0.08)<Pb(0.39)<As(0.47) <Zn((0.64)<Y(0.95)<K(1.07)<Co(1.18)<Zr(1.23)<Rb(1.32)<Sr(1.38)<Fe(1.39) <Cu(1.83)<Ti(2.18). These indices indicated that most of the samples were moderate to strongly pollute by heavy metals showed that the northern and southern parts of the study area are more contaminant than middle portion. The PLI values for 95% of the sample sites were ≥1.5, which consequently indicated deterioration of soil quality.

1.43 Contamination of polycyclic aromatic hydrocarbons (PAHs) in rooftop vegetables and human health implication in Bangladesh

A. R. M. Tareq, R. Sultana, M. F. Ehsan and S. B. Quraishi

Rooftop cultivation of vegetables is considered as a potential food source for urban population. However, rooftop products in the urban area can be contaminated by different types of pollutants like toxic metals and polycyclic aromatic hydrocarbons (PAHs). The present study is the first that investigated the concentrations of PAHs in rooftop soils and vegetables grown in the urban and peri-urban areas of Bangladesh. Red amaranth and Spinach were selected for rooftop cultivation and both soil and vegetable samples were

collected and analyzed for determining the concentrations of PAHs (naphthalene, fluorene, phenanthrene, anthracene, pyrene, benzo(a)anthracene and chrysene). The study observed that urban rooftop soil and vegetables were highly contaminated with PAHs as compared to peri-urban rooftop samples. The concentrations of PAHs were detected in both urban and peri-urban rooftop vegetables. The values of health risk indices revealed that the concentrations of PAHs in urban rooftop vegetables would not pose any carcinogenic and non-carcinogenic health risks for adults and children and thus are considered to be safe for consumption. The findings of this study will provide scientific evidence to the policy makers and public administrations for urban agriculture based policy formulation as well as will encourage the city dwellers towards urban rooftop agricultural practices.

1.44 Vertical and horizontal distribution of polycyclic aromatic hydrocarbons (PAHs) in an urban river sediments affected by tannery effluents

M. F. Ehsan, *S. Sultana, R. Sultan, R. Khan, A. K. M. A. Ullah and A. R. M. Tareq

Exploration of the eight polycyclic aromatic hydrocarbons (PAHs) of the US Environ. Protection Agency priority pollutant list was carried out in sediment samples of a tannery port in the Dhaleshwari River of Bangladesh, which is supposed to be extensively polluted by tannery wastewater discharges. The determination and quantification of PAHs in sediment samples were performed using gas chromatography coupled to mass spectrometry (GC-MS). Concentrations of ∑PAHs are 578.714 $\mu g.kg^{-1}$(dw) in 0-5cm depth, 632.62 $\mu g.kg^{-1}$(dw) in 6-10cm depth,860.90 $\mu g.kg^{-1}$(dw) in 11-15cm depth, 925.876 $\mu g.kg^{-1}$(dw) in 16-20cm depth and 1362.766 $\mu g.kg^{-1}$(dw) in 21-25cm depth with mean concentration of 96.452 $\mu g.kg^{-1}$(dw), 103.937 $\mu g.kg^{-1}$(dw), 107.613 $\mu g.kg^{-1}$(dw), 132.268 $\mu g.kg^{-1}$ (dw) and 170.346 $\mu g.kg^{1}$(dw) respectively. Concentration of PAHs is relatively high in the 21-25cm depth and gradually decreases with the reduces of depth. Among the 25 sediment samples collected, Naphthalene was between ERL and ERM in 7 samples and <ERL in the other 18 samples; Anthracene and Fluorene were between ERL and ERM in one sample ; Pyrene and Chrycene were between ERL and ERM in 4 samples and 21 samples were less than ERL. For Benzo(a)Anthracene, 20 samples were below ERL and 5 samples were between ERL and ERM. Moreover, all 25 samples were below ERL for Phenanthrene and Benzo(a)Pyrene which indicates that biological effects would be rare. The correlation coefficients among the eight PAHs were analyzed. The Phn possesses significant ($p<0.01$) positive correlation with Ant (r= 0.968) and Chy (r=0.692) while it possesses insignificant correlation with other PAHs. The Flu possesses significant ($p<0.01$) positive correlation with Pyr (r=0.737) and Chr (r=0.856). Similarly, significant ($p<0.01$) high correlations were observed between Ant-Pyr (r=0.738),), BaA-Pyr (r=0.877) and Chr-Pyr (r= 0.929) which suggest that these PAHs were originated from similar or common source. The results can be used for regular monitoring and future pollution prevention and management should target the various industries in this region for reducing pollution.

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1.45 Investigation of carcinogenic Benzo (a) Pyrene (BaP) in the sediments of the Dhaleshwari river of Bangladesh affected by tannery effluents

R. Sultana, *S. Sultana, M. F. Ehsan, R. Khan, A. K. M. A. Ullah and A. R. M. Tareq

This research an investigation of carcinogenic Benzo(a)Pyrene (BaP) in sediment samples of a tannery port in the Dhaleshwari River of Bangladesh, which is supposed to be extensively polluted by tannery wastewater discharges. A total of twenty five soil samples from five sampling sites were collected to determine the concentration of benzo(a)pyrene. A suitable method was developed for analysis the BaP in soil samples. The method validity was checked by blank experiment, BaP were detected that's indicated the method validity. All the samples were treated by dichloromethane-hexane (1:1) mixture and refluxed for three hours at 45 °C. The extracted samples were evaporated to 20 mL and pre-concentrated to1-2 mL by using nitrogen gas. Prepared samples were subjected to GC-MS analyses for the identification of BaP. Results showed that the concentration of BaP in soil S-27, S-29, S-40, S-41, S-42, S-43, S-45, S-46, S-48 were found 19.83µg/kg, 0.64µg/kg, 0.59µg/kg, 0.55 µg/kg ,3.86 µg/kg, 9.21 µg/kg, 0.636 µg/kg and 0.236 µg/kg respectively. The highest concentration of S-27 was found 18.83 µg/kg in the depth soil samples of side and lowest concentration was found 0.236 µg/kg in the surface soil of boring site. Benzo[a]pyrene (BaP) was found below detection limit (DL=0.02 µg/kg). The spike recovery of the BaP was found 64.90 to 92.7% demonstrated the perfect reliability and accuracy of the methodology employed in this disquisition.

*Dept. of Environ. science and resource management, UMBST

Clinical Chemistry

1.46 Serum zinc level on 60 pediatric patients suffering from wilson's disease

S. B. Quraishi, A. K. M. A. Ullah, M. N. Alam, M. R. Islam, M. M. Hosen, M. A. Maksud, S. R. Khan, L. N. Lutfa and S. Alam*

The objective of the study was to assess the relationship of serum zinc level on pediatric patients suffering from Wilson's disease. Wilson's Disease (WD) is a rare autosomal recessive genetic disorder of copper (Cu) metabolism resulting to the accumulative deposition of Cu in liver and brain impairing the normal functions of the affected organs. A combination of various parameters is required to establish a diagnosis as no single finding is adequate for diagnosis of WD. In the present study, samples were collected from 55 patients and serum zinc level was determined using atomic absorption spectrometer (AAS). FCPS thesis writing is under progress.

*Bangabandhu Sheikh Mujib Medical University, Dhaka

1.47 Natural antioxidant-based synthesis of silver nanoparticles using some medicinal leaves and their applications against cancerous cell and multidrug-resistant strains

A. K. M. A. Ullah, M. Z. Rahman*, A. R. M. Tareq, S. B. Quraishi, M. M. Rahman* and A. K. M. F. Kibria

Now-a-days, pharmaceutical and biomedical sectors are facing the challenges of continuous increase in the multidrug-resistant human pathogenic microbes. Re-emergence of multi drug resistant microbes is facilitated by drug and/or antibiotic resistance, which is acquired way of microbes for their survival and multiplication in uncomfortable environments. Multidrug resistant bacterial infections lead to significant increase in mortality, morbidity and cost of prolonged treatments. Therefore, the present study was aimed for the development, modification or searching the antimicrobial compounds having bactericidal potential against multi drug resistant bacteria. In the present study, silver nanoparticles (Ag-NPs) have been synthesized using three different medicinal leaf aqueous extracts of *Ocimumtenuiflorum*, *Cynodondactylon* and *Azadirachtaindica* as a source of reducing and stabilizing agents. X-ray diffraction (XRD), transmission electron microscopy (TEM), selected area energy diffraction (SAED), Fourier transform infrared (FT-IR), thermogravimetric (TG) and differential scanning calorimetry (DSC) analyses clearly demonstrate the successful synthesis of Ag-NPs with the variation of bio-molecules encapsulation. The vibrating sample magnetometer (VSM) study clearly demonstrates that the synthesized Ag-NPs showed room temperature ferromagnetic property. The synthesized magnetic Ag-NPs were then exposed against different drug-resistant pathogens of clinical importance (erythromycin, ampicillin and tetracycline resistant *E. coli*, *S. typhimurium* and *S. aureus*) with a suspension of silver nanoparticles (Ag-NPs). Clear zone of inhibitions was obtained indicating the materials as effective drug against multi-drug resistant strains.

*University of Dhaka

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

Name of the person	Title of the event	Organizer	Date	Place
Dr. S. B. Quraishi	Bangladesh Chemical Society Conference-2019	Dept. of Chemistry, RU	9-10 Nov. 2019	RU
	International Conference on Earth and Environ. Sciences & Technology for Sustainable Development ICEEST-2020	Faculty of Earth and Environ. Science, DU	25-27 Jan. 2020	Inter Continental Hotel, Dhaka
Dr. Y. N. Jolly	3rd International Conference on Physics for Sustainable Development and Technology (ICPSDT-2019	Bangladesh Physical Society	18-19 Dec. 2019	CU
	International Conference on Earth and Environ. Sciences & Technology for Sustainable Development ICEEST-2020	Faculty of Earth and Environ. Science, DU	25-27 Jan. 2020	Inter Continental Hotel, Dhaka

Name of the person	Title of the event	Organizer	Date	Place
	International conference on Physics	Bangladesh Physical Society	5-7 Mar. 2020	AECD
Dr. M. S. Rahman	3rd International Conference on Physics for Sustainable Development and Technology (ICPSDT-2019	Bangladesh Physical Society	18-19 Dec. 2019	CU
	International Conference on Earth and Environ. Sciences & Technology for Sustainable Development ICEEST-2020	Faculty of Earth and Environ. Science, DU	25-27 Jan. 2020	Inter Continental Hotel, Dhaka
	4th Young Scientist Congress	Bangladesh Academy of Science	13-15 Dec. 2019	Science Museum, Dhaka
M. J. Kabir	International conference on Physics	Bangladesh Physical Society	5-7 Mar. 2020	AECD
	Bangladesh Chemical congress-2019	RU	9-10 Nov. 2019	RU
Dr. T. R. Choudhury	3rd International Conference on Physics	CUET	18-19 Dec. 2019	CUET
	International Conference on Earth and Environ. Sciences & Technology for Sustainable Development ICEEST-2020	Faculty of Earth and Environ. Science, DU	25-27 Jan. 2020	Inter Continental Hotel, Dhaka
	International conference on Physics	Bangladesh Physical Society	5-7 Mar. 2020	AECD
Engr. S. Akter	3rd International Conference on Physics for Sustainable Development and Technology (ICPSDT-2019	Bangladesh Physical Society	18-19 Dec. 2019	CU
	International Conference on Earth and Environ. Sciences & Technology for Sustainable Development ICEEST-2020	Faculty of Earth and Environ. Science, DU	25-27 Jan. 2020	Inter Continental Hotel, Dhaka
	International conference on Physics	Bangladesh Physical Society	5-7 Mar. 2020	AECD
K. J. Fatema	International Conference on Earth and Environ. Sciences & Technology for Sustainable Development ICEEST-2020	Faculty of Earth and Environ. Science, DU	25-27 Jan. 2020	Inter Continental Hotel, Dhaka
	3rd International Conference on Physics for Sustainable Development and Technology (ICPSDT-2019	Bangladesh Physical Society	18-19 Dec. 2019	CU
	International conference on Physics	Bangladesh Physical Society	5-7 Mar. 2020	AECD
R. M. Tareq	Bangladesh Chemical Congress (BCC2019),	BCS	9-10 Nov. 2019	RU
	International Conference on Physics 2020	BPS	5-7 Mar. 2020	AECD
A. K. M. A. Ullah	Bangladesh Chemical Society Conference-2019	Dept. of Chemistry, RU	9-10 Nov. 2019	RU
	3rd International Conference on Physics for sustainable Development and Technology	Dept. of Physics, CUET	18-19 Dec. 2019	CUET

Name of the person	Title of the event	Organizer	Date	Place
	International Conference on Earth and Environ. Sciences & Technology for Sustainable Development ICEEST-2020	Faculty of Earth and Environ. Science, DU	25-27 Jan. 2020	Inter Continental Hotel, Dhaka
	International Conference on Physics-2020	Bangladesh Physical Society	5-7 Mar.	AECD
K. M. Mamun	International Conference on Earth and Environ. Sciences & Technology for Sustainable Development ICEEST-2020	Faculty of Earth and Environ. Science, DU	25-27 Jan. 2020	Inter Continental Hotel, Dhaka
	International conference on Physics	Bangladesh Physical Society	5-7 Mar. 2020	AECD
R. Sultana	International Conference on Physics 2020	BPS	5-7 Mar. 2020	AECD
M. M. Hosen	Bangladesh Chemical Society Conference-2019	Dept. of Chemistry, RU	9-10 Nov. 2019	RU
	Conference on Environ. Solutions for Sustainable Development: Towards Developed Bangladesh (CESSD 2019)	Forest and Environmntal Affairs Sub-Committee Bangladesh Awami League	27-28 Nov. 2019	CIRDAP, Dhaka and DU
	National Conference on Electronics and Informatics	BES and BAEC	4-5 Dec. 2019	AECD
	International Conference on Earth and Environ. Sciences & Technology for Sustainable Development ICEEST-2020	Faculty of Earth and Environ. Science, DU	25-27 Jan. 2020	Inter Continental Hotel, Dhaka
	International Conference on Recent Advances in Chemistry (ICRAC) - 2020	Dept. of Chemistry, JNU	7-8 Feb. 2020	JNU
	International Conference on Physics-2020	Bangladesh Physical Society	5-7 Mar.	AECD
M. F. Ehsan	Bangladesh Chemical Congress (BCC2019),	BCS	9-10 Nov. 2019	RU
	International conference on Physics	Bangladesh Physical Society	5-7 Mar. 2020	AECD
M. Hasan	Bangladesh Chemical congress-2019	University of Rajshahi	09-10 Nov. 2019	RU
	International Conference on Earth and Environ. Sciences & Technology for Sustainable Development ICEEST-2020	Faculty of Earth and Environ. Science, DU	25-27 Jan. 2020	Inter Continental Hotel, Dhaka
M. H. Sarkar	International conference on Physics	Bangladesh Physical Society	5-7 Mar. 2020	AECD
	International Conference on Earth and Environ. Sciences & Technology for Sustainable Development ICEEST-2020	Faculty of Earth and Environ. Science, DU	25-27 Jan. 2020	Inter Continental Hotel, Dhaka
	International conference on Physics	Bangladesh Physical Society	5-7 Mar. 2020	AECD

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:

- TC project: Building capacity in improving food safety using Nuclear and Other Complementary analytical techniques (BGD/5032), TC cycle 2018-2019
- RAS/7/029 Project: Supporting sustainable air pollution monitoring using Nuclear Analytical Technology
- Coordinate Research Project (CRP) D52038: Food traceability and Food safety of Dairy Products as an example through the Nuclear Analytical Techniques
- IAEA technical cooperation project RAS7037: Enhancing wetland management and sustainable conservation planning (RCA)
- Special Allocation Project (MOST, 2019-2020): Biomonitoring of arsenic and other toxic elements in human scalp hairs of arsenic contaminated areas in Bangladesh

4. Service Rendered and Revenue Income

Sample source	Sample matrix	No. of samples	Income
Patients from different hospitals and clinics	Urine	1957	1565600/-
Patients from different hospitals and clinics	Serum	37	55500/-
Bangladesh Food Safety Authority (BFSA)	Spice	109	218000/-
Bangladesh Food Safety Authority (BFSA)	Pesticide and Fertilizer	68	328000/-
Customs House, ICD Kamlapur, Dhaka	Milk	39	78000/-
Bangladesh Food Safety Authority (BFSA)	Milk	20	40000/-
BRAC Dairy & Food Project	Milk	3	6000/-
ZAS Corporation	Milk	2	4000/-
Customs House, Chattogram	Milk	1	2000/-
Chowdhury & Co.	Milk	1	2000/-
Bangladesh Oceanographic Research Institute	Water	39	340725/-
Beximco Pharmaceuticles Ltd.	Water	2	17000/-
WSTP Circle, Dhaka	Water	2	13000/-
Farzana Diba	Water	2	10000/-
Salam Sea Food	Water	1	8500/-
Farook Sea Foods Ltd.	Water	1	8500/-
Fresh Foods Ltd.	Water	1	8500/-
Int. Shrimps Export (Pvt.) Ltd.	Water	1	8500/-
Khulna Frozen Foods Export Ltd.	Water	1	8500/-
Primus Frozen Foods Ltd.	Water	1	8500/-
Sea Fresh Ltd.	Water	1	8500/-
Rupali Sea Foods Ltd.	Water	1	2500/-
BD Sea Foods Ltd.	Water	1	5000/-
Bangladesh Food Safety Authority (BFSA)	Tobacco Spice	30	180000/-
M/s Mostafa Gul Factory	Tobacco Spice	6	36000/-
M/s Kaus Chemical Works	Tobacco Spice	1	6000/-
M/s Bou Shahajadi Jorda Factory	Tobacco Spice	1	6000/-

Sample source	Sample matrix	No. of samples	Income
Jakir Jorda Factory	Tobacco Spice	1	6000/-
A. Quadir Eagle Tobacco Company	Tobacco Spice	1	6000/-
Akij Food and Beverage Ltd.	Tobacco Spice	1	6000/-
Bangladesh Food Safety Authority (BFSA)	Vegetables	10	20000/-
Bangladesh Food Safety Authority (BFSA)	Molasses	10	20000/-
Salam Sea Food	Shrimp	1	11000/-
Farook Sea Foods Ltd.	Shrimp	1	11000/-
Fresh Foods Ltd.	Shrimp	1	11000/-
Int. Shrimps Export (Pvt.) Ltd.	Shrimp	1	11000/-
Khulna Frozen Foods Export Ltd.	Shrimp	1	11000/-
Primus Frozen Foods Ltd.	Shrimp	1	11000/-
Sea Fresh Ltd.	Shrimp	1	11000/-
Rupali Sea Foods Ltd.	Shrimp	1	2500/-
Bangladesh Food Safety Authority (BFSA)	Yogurt	6	12000/-
FIQC, Chattogram	Fish Feed	2	9000/-
Customs House, Pangaon, Dhaka	Fish Feed	2	9000/-
Bangladesh Ordnance Factories	Mercury	2	5000/-
Saidowla (Pvt.) Enterprise Ltd.	Fish	1	11000/-
Sophia Yang	Catalyst	1	2500/-
BD Sea Foods Ltd.	Sodium Chloride (NaCl)	1	11000/-
BD Sea Foods Ltd.	Non Phosphate (NP-1)	1	11000/-
BD Sea Foods Ltd.	STPP	1	11000/-
BD Sea Foods Ltd.	Breaded Crumbed	1	11000/-
Bangladesh Shilpakola Academy	Gold	Gold-4	10000/-
Ministry of Fisheries and Livestock	Gold, Silver	Gold-8 Silver-9	20000/- 18000/-
Ministry of Public Administration	Gold	Gold-12	30000/-
Export Promotion Bureau	Gold, Silver	Gold-29 Silver-21	72500/- 42000/-
Bangladesh Shishu Academy	Gold, Silver	Gold-2 Silver-1	5000/- 2000/-
Ministry of Shipping	Gold	Gold-10	25000/-
Ministry of Local Government, Rural Development and Co-operatives	Gold	Gold-11	27500/-
University of Dhaka	Gold	Gold-24	60000/-
Ministry of Women and Children Affairs	Gold	Gold-10	25000/-
Ministry of Information	Gold	Gold-63	157500/-
University of Shahjalal University of Science & Technology,Sylhet	Gold	Gold-4	10000/-
Amin Jwellers	Gold	Gold-3	7500/-
Li & Fung (Bangladesh) Ltd.	Gold	Gold-5	12500/-

Sample source	Sample matrix	No. of samples	Income
Ministry of Cultural Affairs	Gold	Gold-21	52500/-
University Grants Commission	Gold	Gold-10	25000/-
Ministry of Youth and Sports, Bangladesh Secretariat	Gold	Gold-40 Silver-40	100000/- 80000/-
Different Hospitals and Clinics	Human Hair	As	130000/-
Custom House Pangaon port, Dhaka	Steel	Fe and Zn	4200/-
Total		2835	4121025/-

Electronics Division, AECD

Objective

Electronics Division has been providing services through repair and maintenance of various types of scientific, medical, analytical, nuclear instruments belonging to all divisions and solar energy unit of Atomic Energy Centre, Dhaka (AECD). The division has also been developing embedded system, PC based system and FPGA based system to facilitate nuclear and analytical research at AECD. This division is also engaged in manpower development through training, Research, Collaboration etc.

Activities

1. Design and Development Work(s)

1.1 Design 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: Design an internet of things (IOT) based system for acquiring nuclear radiation data from the environment as well as monitoring and storing it remotely using web-based user interface.

Nuclear radiation monitoring system is required to acquire and to store nuclear radiation data from the environment. An IOT based radiation monitoring system facilities 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. The major part of the proposed system has two major parts, one is radiation detection unit and another one is wireless communication unit. Radiation detection unit consist of Geiger Muller (GM) detector with high voltage power supply, signal conditioning unit and Arduino as counter and data processor. Radiation data is acquired by radiation detection unit and then it is transmitted to the database server by the node-MCU wireless communication module. A web-based user interface can be design to acquire data from server and to display the nuclear radiation data of the environment. This is an on going work.

1.2 Investigation of electrical gas discharge for solid surface cleaning

M. A. A. Mamun, M. A. Rahman, M. Begum, Y. Yasuoka[*] and A. Hatta[**]

Objective: Established a dry surface cleaning technique by electrical gas discharge inside a vacuum chamber for the investigation of electrical discharge characteristics, mechanism of surface cleaning and surface wettability.

Cleaning of solid surfaces is necessary to attain a defect free surface for offering good adhesion among multiple interfaces in medical and semiconductor industries. Conventional cleaning methods such as wet chemical cleaning or solvent degreasing can enhance the wettability of surfaces and thereby the adhesion, or reduce the contact resistivity. However, a substantial disadvantage of these techniques is to contaminate the treated surface with traces of process chemicals and generate residues that are difficult to dispose. Due to these constrains, dry surface cleaning techniques have attracted currently a great attention by researchers. In this work, a dry surface cleaning technique by electrical gas discharge has been presented. The electrical gas discharge is carried out inside a vacuum chamber using argon (Ar) gas for cleaning a metal surface. The electrical discharge characteristics and surface wettability are investigated. The results show that the control of electrical gas discharge process and treatment time is crucial for successful surface treatment. A successful

surface treatment can effectively remove the surface contaminations such as moisture, grease, oxide and enhance the surface wettability.

*Sinfonia Technology Co., Ltd., Tokyo, Japan
**Graduate School of Engineering, Kochi University of Technology, Kochi, Japan

1.3 Design of a prototype unmanned arial vehicle (UAV) for radiation monitoring and data logging

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

Objective: Perform remote monitoring and logging of radiation data using UAV.

A design of prototype UAV quad-copter has been proposed for radiation monitoring and data logging around 1000 meters line of sight area. According to the design, the proposed quad-copter is capable of carrying a GM-survey meter along with data acquisition, logging and transmission facilities. To fulfill the design criterion a prototype quad-copter was assembled using radio link AT9-S, S500 quad frame with landing gear, KK 2.1.5 flight controller, Emax BL Helli 30A ESC, Emax XA2212 BLDC 980KV Motor, Gemfun 10x4.5" propeller CW+CCW, Wildscorpion 5500mah 11.1v 30c lipo battery and 5.8 GHz 600 mW first person view (FPV) combo with 7" Display. To check the flight stability of the assembled quad-copter, various parameters of flight controller and radio-link remote controller were optimized. But the flight stability of KK 2.1.5 flight controller was not satisfactory. In this work, KK 2.1.5 flight controller has been replaced by Pixhawk PX-4 flight controller for more stable and reliable flight. This is an ongoing work and configuration of various flight parameters for Pixhawk PX-4 flight controller is on test condition.

1.4 Radiation detection and measurement by using a robotic system

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

Objective: Design and develop a fully functional robotic system (UGV- Unmanned Ground Vehicle) for radiation dose measurement in and around the nuclear and radiation environment to ensure human safety.

A robotic system has been designed and developed with a GM counter based survey meter which is being controlled and transferring data (radiation dose level) by Bluetooth communication protocol. The system is functional. But it is necessary to maintain up gradation of such kind of sophisticated device to provide a full proof solid system to be used in real environment. Hence up gradation of the robotic system is going on to make the system more versatile to be used in the nuclear and radiation environment.

1.5 Gamma energy response study of GM detector based survey meter on a robotic system

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

As GM detector is a counter, it is unable to provide the energy level of the radiation. Though the response of the detector is energy dependent. Especially for different energy level of gamma ray, the accuracy of the detector response varies. A robotic system with GM detector based survey meter has been developed for monitoring radiation level. As part of the performance analysis of the system, energy response of the detector has determined experimentally with different radio nuclides.

Geiger Muller is one of the oldest and low cost detectors used for radiation monitoring in and around radiation facilities. The GM detector can detect alpha particles, beta particles, X-ray and Gamma ray based on radiation interaction mechanism. The following energies are considered for the study: i) 662 keV from Cs-137, ii) 1250 keV (avrg) from Co-60 and iii) 1274 keV from Na-22. Based on the study it is found that the response of the GM detector is energy dependent within ±25%. In order to reducing the energy dependency, different filter can be used for energy compensation.

1.6 Design and development of GSM based embedded system for patient's health monitoring

M. T. Khatun, A. Begum, M. U. Safia, M. A. A. Mamun, M. A. Rahman, H. Akhter and M. Begum

Nowadays, healthcare monitoring system is the most considerable issue of the researchers. For this we need a health monitoring system by which we can monitor a patient's health easily any time. Health monitoring system is available in developed countries and it is very expensive. So, an electronic-health monitoring system with low cost is needed for developing countries and rural areas where hospitals are not available. The objective of this work is to observe a patient by measuring temperature and heartbeat of patient and by giving alarming signal in critical condition

The developed system can monitor pulse rate and body temperature of the patient. To display the rate and temperature value, a LCD display is used. To measure pulse rate and temperature of the patient, pulse rate sensor and LM35 sensor are used which are interfaced with microcontroller and LCD display. Upper limit and lower limit are selected for temperature and heartbeat as well. If the temperature and heartbeat increased beyond the upper limit or decreased below the lower limit, then the buzzer received HIGH signal and give alarming sound. Otherwise, the buzzer received LOW signal and alarm gets off. Using GSM module, all information of patient can be sent to relatives of patient through SMS. The buzzer and SMS can help patient's well-wisher to take action immediately. The implementation of the system has been completed and now it is working properly.

1.7 Development of neutron detection system using He-3 neutron detector

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

Ionizing radiation (alpha, beta, γ-rays, X-rays and neutrons) has many beneficial applications in various fields such as medicine, industry, homeland security, agriculture, nuclear power plants and research. As the use of ionizing radiation is increasing day by day, it is very essential to assure proper and confined employment of ionizing radiation because ionizing radiation is very harmful and hazardous for human health as well as the environment. Different types of detection system are used to detect selective types of ionizing radiation. The aim of this work is to develop a neutron detection system.

Our developed system consists of He-3 Neutron detector, Charge sensitive pre-amplifier, Shaping amplifier, Discriminator and Counter. He-3 neutron detector consists of a gas-filled tube and when a high voltage applied across the anode and cathode the analog signal of the detector pulse produces as a result of the passage of radiation through the detector. The detector pulse has very low amplitude and short duration which is fed to the preamplifier. Then the pre-amplifier amplifies the detector pulse and making it suitable for the shaping amplifier. Then the shaping amplifier amplifies the pulse and also increases the pulse width. The discriminator blocks the unnecessary pulses. Counter section is used to count the output pulse of the discriminator. Finally, neutron can be detected with our developed system and can play an important role in nuclear monitoring.

1.8 Face Recognition based embedded system for security applications

A. Begum, A. A. Mamun*, M. T. Khatun, H. Akhter, M. Begum and Z. M. P. Sazzad*

Objective of the work is to design and develop an embedded system for face recognition purpose of security applications.

A face recognition system was developed to ensure security which can be used in office, residential areas, shopping mall etc. In surveillance system, CCTV cameras are used in the bigger cities, shopping-malls, residential areas, which capture low quality video. With those CCTV cameras, a microcontroller was interfaced to supply live images of persons to computer for further processing. Face segmentation technique was used in this work. Histogram of oriented gradient features extraction was used to extract features as dividing existing image and input image from recorded video into blocks and then into cells. These cells consisted of some pixels of image and some of these cells constitute a block. Heterogeneous face matching technique was used to match blocks of these images and identify matched image. Experiment results shows that the method performance is sufficient.

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

1.9 Speech command recognition using MFCC AND VQ classification algorithm

A. Begum, A. A. Mamun*, M. T. Khatun, H. Akhter and M. Begum

Main objective of this work is to develop a system which can identify speech command and work according to those command. It can be used to identify male-female voices.

Speech recognition is necessary to provide commands naturally to a system. Digital recognition of voice command and its implementation in male-female identification is a big challenge. This work represents speech command recognition for that purpose. To extract features of recorded voice MFCC (Mel-frequency cepstral coefficient) algorithm is used in this work. Audio signal preprocessing by A/D conversion with suitable sampling rate is the first stage of this work. After extracting frequency spectrum the analog audio

signal is converted to suitable form namely Mel-cepstram. Mel-cepstrum is further converted to some vector points which represent a significant feature of human speech- pitch. For feature training and classification Vector Quantization (VQ) algorithm is used. In this work, LBG (Linde-Buzo-Gray) VQ (Vector quantization) algorithm is used. It converts the mel-cepstram to some characteristic vector points. It is the centroid of each set of mel-cepstrum. For testing purpose, the Euclidian distance vector is matched with trained set of vectors. It is found that the tested result is successfully matched with previous research.

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

1.10 Microcontroller based toxic gas detection system for septic tank

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

Main objective of this work is to develop a system to detect several toxic gases in septic tank wireless monitoring system.

Various types of toxic gases are found in septic tank such as Carbon-di-Oxide (CO 2), Carbon-mono-Oxide (CO), Hydrogen Sulfide (H 2 S) and so on. These gases are harmful for cleaners working in septic tank, even sometimes it may cause of the death of them due to the presence of high level gases inside the tank. A toxic gas detection system for a septic tank has been developed where MQ-135, MQ-136 and MQ-7 sensors employed for combined detection of CO 2, H 2 S and CO gases respectively. With the change of concentration of gases, the sensor resistance will be changed and accordingly an analogue voltage is produced across the sensor. The analogue voltages from the sensors are fed to a microcontroller which reads the values, converts the values into gas concentration in PPM (parts per million). The PPM values for all three gases are displayed on a LCD, where two levels are assigned as "SAFE" and "DANGER" based on the concentration of each gas. "SAFE" status means the concentration of gas is not harmful and "DANGER" status means the concentration of gas is harmful. A buzzer will give alarm, when the gas concentration status becomes "DANGER". Furthermore, a Bluetooth device is interfaced with the microcontroller for transferring the gas concentration data to a Smart phone. For the Smartphone, application software has been built to monitor the concentration of each toxic gas. The prototype system has been developed and tested which gives satisfactory results. It is supposed to be a helpful and cost effective system for cleaners working in septic tank.

1.11 Design and development of a nuclear counting system using ATMEL microcontroller

M. N. Islam, H. Akhter and M. Begum

Design, Development and Simulation of a Nuclear Counting System using ATMEL Microcontroller has been presented in this project. The Nuclear Counting System (NCS) consists of Nuclear Detector GM (ZP1324)/Scintillation NaI (Tl) followed by Nuclear Detector Signal Channel (NDSC) Preamplifier-Amplifier-Shaper-Discriminator. The charge-sensitive preamplifier decay time constant (τ) is 10 μs. The gain of the amplifier used in this channel is 51. Shaping amplifier with equal time constant ($\tau_1=\tau_2=\tau$) of 5 μs to increase the signal-to-noise ratio. Single ended or integral discriminator function is to eliminate the system noise and pulse height discrimination. Atmel-AVR ATmega8L 8-bit Microcontroller used as the Processor, LCD display (16 ch, 2-line), high voltage power supply (HVPS) for detector bias voltage and low voltage power supply (LVPS). An assembly language counting program based on BASCOM AVR IDE has been developed to control the operation of the designed NCS.

In this research, the design and verification of the ATMEL μC based NCS in Proteus 7.7 simulation platform has been completed successfully. The designed system is cost effective, simple and reliable in operation. The NCS has been tested repeatedly and its performance was found satisfactory. The system can be used for detecting health hazards in nuclear installations and Environ. radiation monitoring.

1.12 Study of a laboratory-based gamma spectrometry for food and Environ. samples

M. N. Islam, H. Akhter, M. Begum, Y. Mawla and M. Kamal*

A comprehensive study on a laboratory-based Gamma Spectrometry has been presented in this research for food and Environ. samples. The system comprises of HPGe detector with proper cooling for minimizing thermal generation of charge-carriers and appropriate shielding to reduce background emission; associated processing electronics and acquisition as well as analysis software. The choice of HPGe detector for laboratory based Gamma Spectrometry, its radiation interaction mechanism and system optimization have been presented.

An elaborate study of laboratory-based Gamma Spectrometry for food and environmental samples have been presented in this study. Syntheses of the system components, system evaluation and optimization have been provided. User interface regarding Gamma Acquisition and Analysis, efficiency calibration, energy calibration and factors affecting the efficiency calibration also have been described briefly. The system is suitable for identifying concentration of low to high energy Environ. radiotracers.

*BAEC, Head Quarters

2. Repair & Maintenance and Renovation Works

During the period major instruments (scientific, industrial and nuclear) of AECD have been repaired. The major instruments include repair Thermostatic Water bath, Hall Probe Machine, HPGe detector, Portable Air Sampler, Hardness tester, Electronic balance, LED Monitor, Computers, (System Unit with software installation), Laptop, Color Printers, Intercom Systems. The Division has been successfully maintaining the Intercom Systems of AECD. The system contains Digital PBX-Board, Panasonic 16SLC having 96 lines and Panasonic D1232, having 16 lines.

Table: Type and number of instruments are repaired

Type of the instruments	Name of the user	Quantity
Scientific, Nuclear and Analytical	AECD	07
Computer (System Unit with software installation)	AECD	13
LED Monitor	AECD	01
Color Printer	AECD	01
Laptop	AECD	01
UPS (Uninterruptible Power Supply)	AECD	03
Intercom System (Line & Set)	AECD	14

3. Manpower Development and Training Program

Title of the event	Date	Place	No. of participant
Industrial Attachment Training program	2 Feb. - 30 Apr. 2020	ED, AECD	17

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

Name of the Participant	Title of the event	Organizer	Date	Place
Engr. M. Begum	National Conference on Electronics and Informatics	BES and BAEC	4-5 Dec. 2019	AECD
	Follow-up Training Course (FTC) on Radioactivity Monitoring Instrument under FNCA Program	BAEC and JAEA	12-16 Jan. 2020	IE, AERE
	Advance Radiation Monitoring Techniques	SAJ ETC	19 Jan. 2020	AECD
	International conference on Physics	Bangladesh Physical Society	5-7 Mar. 2020	AECD
H. Akhter	National Conference on Electronics and Informatics	BES and BAEC	4-5 Dec. 2019	AECD
	Advance Radiation Monitoring Techniques	SAJ ETC	19 Jan. 2020	AECD
	International conference on Physics	Bangladesh Physical Society	5-7 Mar. 2020	AECD
Engr. M. N. Islam	International conference on Physics in Medicine	BAEC, BMPA & BMPT, DU	6-7 Feb. 2020	DU & AECD

Name of the Participant	Title of the event	Organizer	Date	Place
	Closing and Certificate Award Ceremony of the Fifteenth Training Course on Oceanography: Principles and Applications	NOAMI	29 Sept. 2019	Dhaka
	60 Hours Training on Introduction of PIC Microcontroller and Its Application	ED	02 Oct. 2019	Dhaka
	60 Hours Training on Practice in Radiation Measurements and Instrumentation	AECD	07 Nov. 2019	Dhaka
	National Conference on Electronics and Informatics	BES and BAEC	4-5 Dec. 2019	AECD
	An Open Seminar on Nuclear Energy and Sustainable Development	BAEC & IAEA	03 Feb. 2020	Dhaka
	International conference on Physics in Medicine	BAEC, BMPA & BMPT, DU	6-7 Feb. 2020	DU & AECD
	International conference on Physics	Bangladesh Physical Society	5-7 Mar. 2020	AECD
Dr. M. A. A. Mamun	Training on 4 Policy Instruments (NIS, GRS, RTI, CC)	NIGL and PDP	27-28 Nov. 2019	NIGL, Dhaka
	National Conference on Electronics and Informatics	BES and BAEC	4-5 Dec. 2019	AECD
	4th Young Scientists Congress 2019	BAS	13-15 Dec. 2019	NMST
	Follow-up Training Course (FTC) on Radioactivity Monitoring Instrument under FNCA Program	BAEC and JAEA	12-16 Jan. 2020	IE, AERE
	Advance Radiation Monitoring Techniques	SAJ ETC	19 Jan. 2020	AECD
	International conference on Physics	Bangladesh Physical Society	5-7 Mar. 2020	AECD
M. A. Rahman	National Conference on Electronics and Informatics	BES and BAEC	4-5 Dec. 2019	AECD
	International conference on Physics	Bangladesh Physical Society	5-7 Mar. 2020	AECD
	Advance Radiation Monitoring Techniques	SAJ ETC	19 Jan. 2020	AECD
Engr. S. Sattar	International conference on Physics	Bangladesh Physical Society	5-7 Mar. 2020	AECD
	Advance Radiation Monitoring Techniques	SAJ ETC	19 Jan. 2020	AECD
M. T. Khatun	National Conference on Electronics and Informatics	BES and BAEC	4-5 Dec. 2019	AECD
	Follow-up Training Course (FTC) on "Radioactivity Monitoring Instrument" under FNCA Program	BAEC and JAEA	12-16 Jan. 2020	IE, AERE
	International conference on Physics	Bangladesh Physical Society	5-7 Mar. 2020	AECD

Name of the Participant	Title of the event	Organizer	Date	Place
	Advance Radiation Monitoring Techniques	SAJ ETC	19 Jan. 2020	AECD
Begum	National Conference on Electronics and Informatics	BES and BAEC	4-5 Dec. 2019	AECD
	Follow-up Training Course (FTC)/2019 on Nuclear and Radiological Emergency Preparedness Course at BAEC	BAEC and JAEA	24 Nov.-5Dec. 2019	TI, AERE
	International conference on Physics	Bangladesh Physical Society	5-7 Mar. 2020	AECD
	Follow-up Training Course (FTC) on Radioactivity Monitoring Instrument under FNCA Program	BAEC and JAEA	12-16 Jan. 2020	IE, AERE

5. Collaboration Work

Collaboration with different National & International Universities

Experimental Physics Division, AECD

Objective/Introduction

The key objective is to develop solar energy materials and advanced materials in thin film form for solar photovoltaic and different optoelectronic applications. These are summed up bellow:

- Development and characterization of elemental, binary, ternary and quaternary semiconducting materials in thin film form
- Fabrication of photo detectors and characterization
- Studies of the fundamental properties of solid state materials in optoelectronic and nuclear science application

Activities

1. Research and Development Work(s)

1.1 Investigated of ZnS thin film by chemical deposition technique

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

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

Current progress: The effects of Complexing Agent Tri Sodium Citrate on the Structural properties of ZnS films are observed. The thin films of ZnS have been grown on glass substrates by chemical bath deposition technique. The structural optical, elemental, morphological and bonding information were investigated by X-ray Diffraction (XRD), UV-VIS-NIR spectroscopy, Energy Dispersive Spectroscopy (EDS), Scanning Electron Microscopy (SEM), Fourier-transform Infrared Spectroscopy (FTIR) respectively. From X-ray diffraction patterns it was found cubic phases preferred orientation. Maximum transmittance was found 70 nm in the visible region and optical band gap was determined near about 3.65 eV using transmittance data. It was also observed that the band gap varies with changing the Complexing Agent. FTIR spectra confirmed the successive formation of Zinc Sulfide (ZnS) thin film samples. These films can be used as one of the important components for solar cell and opto-electronic applications.

1.2 Dependence of optical properties of CdTe thin films on growth parameters

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

Objective: Analysis of structural, optical and electrical properties of CdT**e** hin film

Current progress: Thin films of Cadmium Telluride (CdTe) have been deposited onto an ultrasonically cleaned glass substrate by sequential and successive thermal evaporation method. The films thickness were 50 (20nm at S_T 300^{0}C and 30 nm at S_T 200^{0}C; 100 (40 nm atS_T 300^{0}C and 60 nm at S_T 200^{0}C and 200 (80nm at S_T 300^{0}C and 120 nm at S_T 200^{0}C) having the fixed thermal annealing temperature for duration 1 hour. The

quality of the films has been ascertained by their optical properties in the photon wavelength 300nm to 2500nm. It was found that the transmittance of the films was decreasing with increasing the film thickness and reflectance was decreasing with increasing the film thickness in the infrared region. Maximum transmittance was found about 83% in the visible wavelength for the film of thickness 100 nm and maximum reflectance was found about 49% in the ultraviolet region for the film of thickness 50 nm.

1.3 Synthesis and characterization of Zinc Sulfide (ZnS) and Cr doped ZnS thin films using chemical bath deposition (CBD)

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

Objective: Analysis of structural, optical and electrical properties of ZnS and Cr doped ZnS thin films

Current progress: Zinc sulfide (ZnS) is II-VI semiconductors material which has a wide direct band gap. Due to its wide energy band gap nature it has various applications in optoelectronics application such as blue light-emitting diodes, electro optic modulator, optical coating, electroluminescent devices and photovoltaic cells. The ZnS thin film can be made in various processes. We used the chemical bath deposition process due to its simplicity and low cost. Thin films of ZnS have been deposited on glass substrates by chemical bath deposition (CBD) method taking ammonia and trisodium citrate dihydrate as complexing agent. The source of Zn ion is the zinc salt such as zinc acetate and the source of sulfur ion is thiourea. The pH of the solution was maintained at 9−10 at a temperature of 80°C. Annealing effect was also checked. Structural optical and morphological properties were studied for the films using X-ray Diffraction (XRD), UV-VIS-NIR Spectrophotometre, FTIR, Raman Spectroscopy, Scanning electron microscope (SEM). XRD showed development of well-crystallized film after increasing the ratio of thiourea and replacing the complexing agent. Maximum transmittance was found about 70% in the visible region from the optical measurement.

1.4 Radiation effect on the optical properties of CdTe thin film deposited by thermal evaporation method

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

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

Current progress: CdTe thin films of 50 nm (30 nm at 300^0C S_T and 20 nm at 200^0C S_T), 100nm (60 nm at 300^0C S_T and 40 nm at 200^0C S_T) and 200 nm (120 nm at 300^0C S_T and 40 nm at 80^0C S_T) have been deposited on the glass substrate at fixed annealing temperature 100^0C 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.

1.5 CdZnS thin film synthesis & characterized by cheical bath deposition (CBD) technique

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

Objective: Deposition and measurement of structural, optical properties of CdZnS thin films

Current progress: Cadmium Zinc Sulfide (CdZnS) thin films were synthesized by chemical precipitation method. CdZnS thin films on different ratio of Cd and Zn are deposited on glass substrate. Thin films were prepared at 80^0C temperature for 30 min. & annealing temperature $A_T = 150^0$C for 60 min. Analysis of the parameters are going on.

1.6 Optoelectronic characterization of Zinc Oxide (ZnO) nanoparticles by chemical precipitation technique

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

Objective: Analysis of optical & structural properties of ZnO Nano powder.

Current progress: ZnO is a wide band gap semiconductor mainly attractive for its potential applications as a window and conducting material or transparent conducting oxide in photovoltaic devices. Study of the effect of process parameters on the quality of the final product is an active area of research till today. We prepared ZnO powder by a simple chemical precipitation method. Zincaccetatedihydrade ($Zn(Ch_3COO)_2$. $2H_2O$) was used as a complexing agent which was dissolved into 50ml of Isopropanol (C_3H_8O). The mixture was

vigorously stirred at 60^0C for 30 min to completely dissolve the solute into the solvent. During the growth process, monoethyleamin which was used a stabilizer added drop wise into the solution under constant stirring at 60^0 C for 2hours. Thus a transparent and homogeneous solution was obtained. Here we prepared three different ZnO samples by varying the amount of monoethylamin. We used monoethylamin respectively 25,12 and 6 drops and nanoparticles were deposited after 261h,260.5h and 91hour aging of the solution. They were dried in an oven at 120^0C for 3h. pH value was kept respectively in between 8.2-12.3,6.5-7.7 and 5.8-6.9.The structural characterization of ZnO nano powders was performed by X-ray diffraction method.

1.7 Effect of annealing temperature on structural, morphological and optical properties of undoped CdSe thin films by chemical bath deposition (CBD) technique

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

Objective: Analysis of CdSe thin film

Current Progress: Effect of annealing temperature on the properties of CdSe thin films are carried out in this work. Undoped CdSe thin films with Unannealed and different annealed temperature were synthesized by relatively easy Chemical Bath Deposition (CBD) Technique. These films were annealed at 100^0C, 200^0C and 300^0C for 1 hour each. Unannealed & annealed thin films were studied using XRD, SEM and UV-VIS-NIR. The surface morphology and properties studied by SEM and the crystal structure of CdSe thin film was studied by X-ray diffraction. The crystallite size and lattice constant of CdSthin films were investigated. The optical parameters such as transmittance, absorption coefficient and energy band gap of the films were investigated by UV-VIS-NIR. Thickness of Unannealed film was 203.4 nm and annealed films were 203.1nm, 201.1nm and 203nm respectively. The films produced by the method confirmcubic structure. 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.

1.8 CdS Nanoparticles synthesized by chemical precipitation technique and characterized for its potential technological applications

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

Objective: Synthesis & characterization of CdS nano powder.

Current Progress: Cadmium Sulfide (CdS) nano particles were synthesized by chemical precipitation method. Cadmium Cloride and Thiourea were used as the precursor materials. Ammonia water & distilled water were used as solvent. The sample annealed at 100°C for 1 hour. Structural properties and elemental properties of CdS nano particles were investigated. Synthesized nano particles showed structural properties after annealing. The samples were characterized by X-ray diffraction (XRD), Fourier Transform Infrared (FTIR) and Transmission Electron Microscopy (TEM). XRD studies reveal that CdS crystallizes in double phase of cubic and hexagonal structure. FTIR spectra confirmed the presence of CdS nano particles in the sample. In this research CdS has been studied due to its potential technological applications in field effect transistors, solar cells, photovoltaic, light emitting diodes, photo catalysis, photoluminescence, infrared photo detector, Environ. sensors, biological sensors etc.

1.9 Preparation and characterization of SnS_2 Thin film deposited by spin coating technique

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

Objective: To observe the SnS2 thin film and also measure the parameters of this sample.

Current progress: SnS_2 thin films with constant speed and different deposition time were prepared by simple and relatively easy spin coating method. Staniccloridepentrahydrate, Thioacetamide were used as the precursors whereas Amoniumcloride, Distilled water and Triethyleamine worked as solvent and stabilizer respectively. All the samples prepared at 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. The Reflectance spectra revealed a decreasing nature with increased deposition time of the constant speed the thin films. The band gap of the samples varies from 3.54eV to 3.56eV. The samples

will be characterized by X-ray Diffraction (XRD), Scanning Electron Microscopy (SEM) and Fourier-transform Infrared Spectroscopy (FTIR). These films can be used as one of the important components for solar cell and electronic applications.

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

Name of the participant	Title of the event	Organizer	Date	Place
Dr. K. M. A. Hussain	Conference on Environ. Solutions for Sustainable Development: Towards Developed Bangladesh	Forest and Environ. Affairs Sub-Committee, Bangladesh Awami League	27-28 Nov. 2019	Press Club, Dhaka
	National Conference on Electronics and Informatics	BES and BAEC	4-5 Dec. 2019	AECD
	3rd International Conference on Physics for Sustainable Development and Technology (ICPSDT-2019	Bangladesh Physical Society	18-19 Dec. 2019	CU
	International conference on Physics	Bangladesh Physical Society	5-7 Mar. 2020	AECD
Dr. M. T. Chowdhury	National Conference on Electronics and Informatics	BES	4-5 Dec. 2019	AECD
	3rd International Conference on Physics for Sustainable Development and Technology (ICPSDT-2019	Bangladesh Physical Society	18-19 Dec. 2019	CU
	International conference on Physics	Bangladesh Physical Society	5-7 Mar. 2020	AECD
M. S. S. Chowdhury	Conference on Environ. Solutions for Sustainable Development: Towards Developed Bangladesh	Forest and Environ. Affairs Sub-Committee, Bangladesh Awami League	27-28 Nov. 2019	Press Club, Dhaka
	National Conference on Electronics and Informatics	BES	4-5 Dec. 2019	AECD
	3rd International Conference on Physics for Sustainable Development and Technology (ICPSDT-2019	Bangladesh Physical Society	18-19 Dec. 2019	CU
	International conference on Physics	Bangladesh Physical Society	5-7 Mar. 2020	AECD
T. Faruqe	Conference on Environ. Solutions for Sustainable Development: Towards Developed Bangladesh	Forest and Environ. Affairs Sub-Committee, Bangladesh Awami League	27-28 Nov. 2019	Press Club, Dhaka
	National Conference on Electronics and Informatics	BES	4-5 Dec. 2019	AECD
	International Conference on Physics for Sustainable Development and Technology (ICPSDT-2019)	Dept. of Physics, CU	18-19 Dec. 2019	CUET
	International conference on Physics	Bangladesh Physical Society	5-7 Mar. 2020	AECD
J. Parvin	National Conference on Electronics and Informatics	BES and BAEC	4-5 Dec. 2019	AECD

Name of the participant	Title of the event	Organizer	Date	Place
	3rd International Conference on Physics for Sustainable Development and Technology (ICPSDT-2019	Bangladesh Physical Society	18-19 Dec. 2019	CU
	International conference on Physics	Bangladesh Physical Society	5-7 Mar. 2020	AECD
F. T. Z. Toma	Conference on Environ. Solutions for Sustainable Development: Towards Developed Bangladesh	Forest and Environ. Affairs Sub-Committee, Bangladesh Awami League	27-28 Nov. 2019	Press Club, Dhaka
	National Conference on Electronics and Informatics	BES and BAEC	4-5 Dec. 2019	AECD
	International Conference on Physics for Sustainable Development and Technology (ICPSDT-2019)	Dept. of Physics, CU	18-19 Dec. 2019	CUET
	International conference on Physics	Bangladesh Physical Society	5-7 Mar. 2020	AECD

3. Arranged Training Program

Arranged Nuclear Engineering Training Program, 15-30 December, 2019, AECD.

4. Collaboration Work(s)

Collaboration with teachers and research students of

- Dept. of Physics and Dept. of Electrical and Electronic Engineering, University of Dhaka (PhD thesis, M.S thesis, B.Sc. report)
- Physics Dept., Dhaka University of Engineering & Technology (M.Phil. thesis)
- Physics Discipline, Khulna University (B.Sc. report/M.S. thesis)
- Dept. of Electrical and Electronic Engineering, University of Chittagong (M.S. thesis)
- Dept. of Glass and Ceramic Engineering (BUET)
- Every year students carry out their thesis work in the laboratories of the Division

Health Physics Division, AECD

Objective

- Population exposure control
- Occupational exposure control
- Medical exposure control
- Radiation protection services

Radiation and radioactivity in Environ. samples & imported/exportable foods (except Chittagong and Mongla Port) are being monitored as per requirement of the NSRC rules 1997 and BAER Act-2012. This division is the only provider of Individual Monitoring Services (IMS) of occupational workers throughout Bangladesh; this is mandatory as per NSRC rules 1997 and BAER Act-2012. Health Physics Division is one of the most important Technical Support Organization (TSO) of ongoing Rooppur Nuclear Power Plant (RNPP). This division has been provided nuclear and radiological emergency services in case of any incident or accident.

Programe

Environmental Radiation & Radioactivity Monitoring

- Measurement of background radiation levels throughout Bangladesh and assessment of population exposure

- Analysis of different radionuclides in Environ. and biological samples both qualitatively and quantitatively
- Development and standardization of analytical methods for low level measurement of radioactivity in Environ. samples
- Measurement of Environ. gamma dose by Thermo-luminescent Dosimeter
- Estimation of radioactivity concentration in Naturally Occurring Radioactive Materials
- (NORM) samples of different gas fields
- Measurement of Environ. gamma doses by In-Situ method
- Assessment of Gross Alpha and Gross Beta activity in Environ. samples
- Determination of the Radon concentration in Environ. 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 Dept.

Medical Exposure Control

- Control of medical exposure by measuring of patient's surface dose of cardiac patient during CAG and PTCA
- Measurement of patient surface dose during CT examination.

Quality Assurance Program for Radioactivity Measurement

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

Quality Assurance Program of Individual Monitoring System

- Performance test of TL Dosimeter system through routine test and calibration
- Participation in the intercomparison 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, M. S. Rahman, J. Ferdous, A. K. M. M. Rahman, M. M. M. Siraz, S. Pervin, N. Hassan, S. Banik, 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 to 0.25) $\mu Sv.h^{-1}$. 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, M. S. Rahman, J. Ferdous, A. K. M. M. Rahman, M. M. M. Siraz, S. Pervin, N. Hassan, S. Banik, 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 (0.50 - 2.15) $\mu Sv.h^{-1}$, (0.20 - 0.45) $\mu Sv.h^{-1}$, (0.50 - 4.80) $\mu Sv.h^{-1}$ and (0.25-0.45) $\mu Sv.h^{-1}$ 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, M. S. Rahman, J. Ferdous, A. K. M. M. Rahman, M. M. M. Siraz, S. Pervin, N. Hassan, S. Banik, Z. Hossain and A. Joydhar

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

Current progress: During the reporting period, twenty rain water samples were collected from AECD campus, Tongi and Mirpur area. The activity concentration of natural radionuclides ^{238}U, ^{232}Th, ^{40}K and artificial radionuclides (if any) 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. No artificial radionuclide was observed.

1.4 Radioactivity concentration of different food samples imported from SAARC and other countries

S. Yeasmin, M. S. Rahman, J. Ferdous, A. K. M. M. Rahman, M. M. M. Siraz, S. Pervin, N. Hassan, S. Banik, 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 41 (forty one) 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. No artificial radionuclide was observed.

1.5 Measurement of radioactivity in powdered milk and evaluation of the corresponding annual effective dose

M. S. Dunia*, M. M. M. Siraz, R. Rahman*, S. Pervin and S. Yeasmin

Objective: To determine the activity concentration of natural and artificial radionuclides (if any) for powdered milk samples.

Current Progress: The activity concentration of natural and artificial radionuclides (if any) has been assessed for twenty powdered milk samples that are frequently consumed collected from local markets at Dhaka city in Bangladesh using a High Purity Germanium Detector with relative efficiency of 19.6% coupled with a Digital Spectrum Analyzer (DSP^{ec}jr 2.0). The range of activity concentration of ^{226}Ra, ^{232}Th and ^{40}K of powdered milk samples are varied from 3.91±10.16 to 59.71±25.72, from 2.67±2.2 to 68.31±8.58 & from 14.9±56.75 to 1042.47±83.86 $Bqkg^{-1}$ respectively. The estimated annual effective doses due to the intake of powdered milk are varied from 52.09 to 225.89 µSv/year for adults which are lower than the FAO/WHO and ICRP (2007) recommended limit of 1.0 mSv/year per food group for all ages. The resulting data may provide as base-line levels of activity concentration for natural and artificial radioactivity in powdered milk and may help to establish national rules and regulations of powdered milk relating to radiological protection for the relevant population.

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1.6 Assessment of natural radioactivity in coal and soil samples collected from Barapukuria coal mine in Dinajpur district of Bangladesh

M. I. A. Chowdhury*, M. M. M. Siraz, S. Pervin, A. F. M. M. Rahman**, M. J. Dewan* and S. Yeasmin

Objective: To determine the natural radionuclides and their activity concentration in coal and soil samples

Current Progress: Total six coal and eleven soil samples were collected from Barapukuria Coal Mine in Dinajpur District of Bangladesh. All the samples were processed following the standard procedures as per International Atomic Energy Agency (IAEA) guidelines. The samples were stored for at least four weeks before counting in order to allow the in-growth of uranium and thorium decay products and achievement of equilibrium for ^{238}Uranium and ^{232}Thorium with their respective progeny to get ready for measurements. The detection and measurement of radionuclides in the samples will be carried out by gamma spectrometry system using a high-resolution HPGe coaxial detector coupled with DSPEC jr 2.0 Digital Signal Processing Gamma Ray Spectrometer. The work is in progress.

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[**]Nuclear Power and Energy Division, Bangladesh Atomic Energy Commission

1.7 Study of radioactivity and assessment of radiological hazard in soil and water samples collected from various regions in the southern part of Bangladesh

M. M. M. Siraz, A. F. M. M. Rahman[*], S. Pervin, S. Banik, Z. Hossain, A. Joydhar and S. Yeasmin

Objective: To measure the radioactivity and assess the radiological hazard associated with soil and water Samples

Current progress: Under the project, "Survey for the probable site for the Nuclear Power Plant in the Southern area of Bangladesh", total twenty seven soil and twenty seven water samples were collected from Nishanbaria (West), Nishanbaria (East) and Kumirmara of Borguna district in the southern part of Bangladesh. All the samples will be processed following the standard procedures as per International Atomic Energy Agency (IAEA) guidelines. The collected samples will be analyzed by Gamma Spectrometry System consists of a high-purity germanium (HPGe) detector with relative efficiency of 19.6% coupled with a Digital Spectrum Analyzer (DSPec jr 2.0). The work is in progress.

[*]Nuclear Power and Energy Division, Bangladesh Atomic Energy Commission

1.8 Assessment of occupational exposure using TLD in Bangladesh

S. Yeasmin, M. M. M. Siraz, S. Pervin, S. Banik and M. S. Rahman

Objective: To assess and analyze the occupational exposure to ionizing radiation in the fields of Cardiology, Nuclear Medicine, Industrial Radiography and Radiotherapy

Current progress: The TLD system in use is based on TL card containing two elements of LiF:Mg, Ti (TLD-100) for the evaluation of $H_p(10)$ and $H_p(0.07)$ which have been read out by Harshaw TLD reader (Model-4500). All radiation workers are being monitored on a quarterly basis using whole body TLD badges. The average annual effective dose received by the radiation workers in the fields of Cardiology, Nuclear Medicine, Industrial Radiography and Radiotherapy from the year 2014 to 2018 is 620, 50, 10, 50 & 90 μSv; 110, 170, 150, 40 & 80 μSv; 1330, 340, 400, 290 and 230 μSv; 100, 90, 80, 20 & 5 μSv respectively. The cumulative dose of all the radiation workers in the fields of Cardiology, Nuclear Medicine, Industrial Radiography and Radiotherapy from the year 2014 to 2018 is 164.17, 174.68, 261.36 and 52.03 mSv respectively. From this study, it can be concluded that although most of the radiation workers (82%) received lower doses (less than 1mSv quarterly)-only a few workers (0.8%) received higher doses (greater than 5 mSv quarterly), the workers should pay more attention to radiation protection procedures and practices to keep radiation dose as low as reasonably achievable (ALARA).

1.9 Measurement of effective dose and estimation of radiological hazard to radiation workers in interventional cardiac Procedures

M. M. M. Siraz, M. S. Rahman, S. Pervin, Z. Hossain and S. Yeasmin

Objective: To assess and analyze the occupational exposure to ionizing radiation in interventional cardiology practices in Bangladesh for the last year 2019

Current progress: Effective dose to radiation workers was measured by TLD card containing two elements of LiF:Mg,Ti (TLD-100) which have been read out by Harshaw TLD reader (Model-4500) in Health Physics Division, Atomic Energy Center Dhaka for quarterly basis. The average annual effective dose and the cumulative dose received by the 263 (Medical Doctor, Medical Physicist and Staff) radiation workers in the field of Cardiology in 2019 are 0.1185 mSv and 31.17 mSv respectively. From this study, it can be concluded

that although no radiation worker received higher doses (greater than 20 mSv, which is the 5 year average radiation worker dose limit recommended by IAEA Safety Standards GSR Part 3), the radiation workers should pay more attention to radiation protection procedures and practices to keep radiation dose as low as reasonably achievable (ALARA).

1.10 Measurement of Environ. gamma dose rate and evaluation of annual effective dose to population in AERE campus

M. M. M. Siraz, S. Pervin, A. F. M. M. Rahman*, M. S. Rahman and S. Yeasmin

Objective: To measure outdoor Environ. gamma-ray dose rates from natural and artificial radionuclides (if any) releasing from radiological/nuclear facilities in the country or from neighbouring countries in normal operation or in case of incident/accident through in-situ technique.

Current progress: In this study, total twenty monitoring points (MP), marked-out using Global Positioning System (GPS) navigation, were selected for measurement of gamma-ray dose rate at one meter above the ground in the outdoor environment of different facilities in Atomic Energy Research Establishment (AERE) using real-time digital portable radiation monitoring device Gamma Scout. The outdoor Environ. gamma dose rate for these MPs were ranged from 0.12μSv/hr to 0.20 μSv/hr with an average of 0.15μSv/hr and the associated annual effective dose to the population from outdoor Environ. gamma radiation was varied from 0.210 mSv to 0.350 mSv with an average of 0.268 mSv, which is comparable to other parts of Bangladesh as well as in different regions around the world. Therefore, it can be concluded that adequate safety and radiation protection of radiological facilities had been ensured which is required for minimizing of unnecessary exposure to populations from man-made sources.

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1.11 Study on outdoor Environ. gamma radiation of new market thana by in-situ method

M. S. Rahman, I. K. Sumi*, S. Yeasmin, M. M. M. Siraz, S. Pervin, S. Banik, Z. Hossain and K. N. Sakib*

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

Current Progress: In-Situ Environ. gamma-ray dose rate was measured at 32 locations of New Market Thana under Dhaka district using real-time Environ. 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 μSv/h with an average of 0.145 μSv/h. The annual effective dose of the population due to the Environ. gamma radiation was also calculated and it was varied from 0.104 - 0.233 mSv.

*Dept. of Physics, MBSTU

1.12 Study on indoor & outdoor gamma radiation of INMAS Mitford hospital campus by in-situ method

M. S. Rahman, A. Habib*, S. Yeasmin, M. M. M. Siraz, S. Pervin, S. Banik, Z. Hossain and P. K. Das*

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 Dept.s in order to ensure safe working environment of workers.

Current Progress: In-Situ indoor radiation was measured at 32 locations of INMAS, Mitford 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 indoor radiation dose rate varied from 0.151- 4.31 μSv/h with an average of 0.456 μSv/h. The annual effective dose of the population due to the indoor gamma radiation was also calculated and it was varied from 0.305 - 8.764 mSv.

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1.13 Study on indoor & outdoor Environ. radiation of DMCH by in-situ method

M. S. Rahman, F. S. Mim*, S. Yeasmin, M. M. M. Siraz, S. Pervin, S. Banik, Z. Hossain and S. M. Tareq*

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

Current Progress: In-Situ Environ. gamma-ray dose rate was measured at 32 locations of DMCH campus using real-time Environ. 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 0.095-0.580 µSv/h with an average of 0.147 µSv/h. The annual effective dose of the population due to the Environ. gamma radiation was also calculated and it was varied from 0.832 - 1.621 mSv.

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1.14 Study on outdoor radiation of BSMMU hospital campus by in-situ method

M. S. Rahman, F. Hassan*, S. Yeasmin, M. M. M. Siraz, S. Pervin, S. Banik, Z. Hossain and S. 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 Dept.s in order to ensure safe working environment of workers.

Current Progress: In-Situ indoor radiation was measured at 32 locations of BSMMU 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 indoor radiation dose rate varied from 0.181- 15.182 µSv/h with an average of 1.054 µSv/h. The annual effective dose of the population due to the indoor gamma radiation was also calculated and it was varied from 0.279 - 23.514 mSv.

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1.15 Radiation monitoring at indoor places of AECD campus by in-situ method

M. S. Rahman, O. Faruque*, S. Yeasmin, M. M. M. Siraz, S. Pervin, S. Banik, Z. Hossain and K. N. Sakib*

Objective: To measure the indoor radiation of AECD Campus from natural and artificial radionuclides

Current Progress: Indoor radiation was measured at 20 locations of AECD Campus using thermoluminescent dosimeters. The measurement was performed from Nov 2019-Apr. 2020. The indoor radiation dose rate varied from 352- 482 µSv/month with an average of 354 µSv/month. The annual effective dose of the population due to the indoor gamma radiation was also calculated and it was varied from 1.279 - 3.114 mSv.

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1.16 Study on outdoor Environ. gamma radiation of Demra thana by in-situ method

M. S. Rahman, S. Hossain*, S. Yeasmin, M. M. M. Siraz, S. Pervin, S. Banik and Z. Hossain

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

Current Progress: In-Situ Environ. gamma-ray dose rate was measured at 32 locations of Demra Thana using real-time Environ. 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 0.086-0.197 µSv/h with an average of 0.147 µSv/h. The annual effective dose of the population due to the Environ. gamma radiation was also calculated and it was varied from 0.832 - 1.621 mSv.

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1.17 Study on indoor radiation of AECD campus by thermoluminescent dosimeter

M. S. Rahman, M. R. Islam*, S. Yeasmin, M. M. M. Siraz, S. Pervin, S. Banik, Z. Hossain and K. N. Sakib*

Objective: AECD workers usually handle radioactive sources during service and R & D activities. 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 AECD Campus in order to ensure safe working environment of workers.

Current Progress: Indoor radiation was measured at 20 locations of AECD Campus using thermoluminescent dosimeters. The measurement was performed from Nov 2018-Apr. 2019. The indoor

radiation dose rate varied from 352- 482 μSv/month with an average of 354 μSv/month. The annual effective dose of the population due to the indoor gamma radiation was also calculated and it was varied from 1.279 - 3.114 mSv.

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1.18 Effective dose received by occupational workers handling radioisotopes (^{131}I and ^{99m}Tc) in INMAS, Dhaka, as determined from bioassay sample.

Y. Noor*, J. Ferdous, N. Ahsan*, M. S. Reza**, M. M. M. Siraz, S. Pervin, S. Banik, Z. Hossain and S. Yeasmin

Objective: To estimates the potential health risks attributed to internal contamination of occupational workers at INMAS, Dhaka, during nuclear medicine practices involving the radionuclides ^{131}I and ^{99m}Tc from urine sample using *in vitro* method.

Current Progress: As a part internal radiation monitoring, total of 55 urine samples from 6 occupational workers are collected over a period of about 11 months of handling radioisotopes at INMAS, Dhaka. These urine samples are analyzed using a High Purity Germanium (HPGe) detector. The count for a specific energy is proportional to (i) the intensity of the radiation intake of the worker, (ii) the emission probability of that energy and (iii) the detector efficiency. It also depends on the distribution of the radioisotope inside a human body, as well as the time between an intake and its analysis. All these are taken into account while calculating the effective doses. The annual effective dose values, as found in this study, range from 4.56×10^{-5} mSv to 9.72×10^{-3} mSv, which are well below the International Commission on Radiological Protection (ICRP) recommended annual dose limit of 20 mSv. Hence it appears to be reasonable to assume that even without the errors in the results due to various limitations of this method, the results stay below the recommended limit.

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1.19 Comparison of two different types of LiF:Mg,Ti thermoluminescent dosimeters for detection of radiation from ^{90}Sr/^{90}Y source

A. K. M. M. Rahman, F. Rahman*, N. Hossain*, G. M. M.Rahman*, M. M. M. Siraz, S. Pervin, S. Banik, N. Hassan and S. Yeasmin

Objective: Thermoluminescent dosimetry material consists of Lithium Fluoride (Li natural) LiF:Mg, Ti, suitable for health and medical physics dosimetry applications. The aim of this work is to compare the response obtained with the TLD chips of TLD-100 (LiF: Mg, Ti-7.5%^{6}LiF) and TLD-700 (^{7}LiF:Mg,Ti-99.9%^{7}LiF) under ^{90}Sr/^{90}Y irradiation. The TLD-100 and TLD-700 is amply used to obtain the information of radiation dose such as gamma, beta due to the presence of difference in the concentration of isotopes of Li. In the present study, a TLD reader (Harshaw Model 3500) was used to readout the samples in a flowing N_2 atmosphere to reduce surface oxidation. In this work, thirty TLD chips of two different types, TLD-100 and TLD-700, were used. The composition of the dose in different types of TLDs was evaluated for dosimetry, focusing on linearity and repeatability.

Current progress: It was found that the response of TLD 700 is 1.2 times greater than that of TLD-100 and the repeatability tests made on two types of chips were very satisfactory. The dosimetric property of this study is guided for correct measurement of ionizing radiation doses.

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1.20 Thermoluminescent dosimeters for low dose measurements

Y. Akter*, A. K. M. M. Rahman, H. Sahadath*, M. M. M. Siraz, S. Pervin, S. Banik, Z. Hossain and S. Yeasmin

Objective: Investigation of thermoluminesence response of TLD-100 in low radiation dose environment. Ten standard TLD-100 chips were irradiated at different low dose radiation namely 46.82μGy, 93.82μGy, 140.73μGy, 187.54μGy and 234.1μGy with ^{90}Sr/^{90}Y Irradiator and read in Harshaw 4500 TLD Manual Reader. Following the reading, detection limit, linearity, repeatability, variation of standard deviation and coefficient of variation were investigated. After that the same TLDs were irradiated at dose of 140.46μGy and fading test was incorporated for 7 days. TLD-100 upon low dose irradiation showed good linear response (Coefficient of Determination, R^2~1) as well as lower detection limit (D_L).

Current progress: The value of D_L has been found 40μGy Standard deviation and coefficient of variation form decreasing pattern with increasing low radiation. For a very short time period like 7 days, TLDs showed irregular response. These investigations help to conclude that TLD-100 can be used for low dose environment with proper calibration and correction factor calculation.

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1.21 The activity concentration of radionuclides (^{226}Ra, ^{232}Th and ^{40}K) in soil samples and associated health hazards in natore, Kushtia and Pabna district of Bangladesh

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Objective: To measure the activity concentration of natural and anthropogenic radionuclides in fifteen (15) soil samples of Natore, Kushtia and Pabna district, which are around the 30 km peripheral area of Rooppur Nuclear Power Plant, by gamma ray spectrometry system using a High Purity Germanium (HPGe) detector

Current progress: It is found that the activity concentration of ^{226}Ra, in the collected sample was from 3.52 Bq/kg to 28.5 Bq/kg with the average value of 12.42 Bq/kg. For ^{232}Th, the range was from 4.18 Bq/kg to 34.5 Bq/kg with the average value of 12.6 Bq/kg. Finally, the activity concentration of 40K, in the collected sample was in the range of 84 Bq/kg to 345 Bq/kg and the average value was 198.9 Bq/kg. The absorbed dose rate (D) was found to be in the range of 4.59 nGy/h to 40.93 nGy/h with the mean value 21.3 nGy/h. The annual effective dose (E) was in the range of 0.006 mSv/yr to 0.152 mSv/yr with an average of 0.033 mSv/yr. The radium equivalent activity was in the range from 10.02 Bq/kg to 89 Bq/kg with an average of 44.99 Bq/kg. The external hazard index (H_{ex}) was found to be in the range of 0.027 to 0.242 with the mean value of 0.121 and the internal hazard index (H_{in}) was found to be in the range of 0.044 to 0.302 with the mean value of 0.156. All the values are much below the recommended limit by the United Nations Scientific Committee on the Effects of Atomic Radiation (UNSCEAR), 35 Bq/kg for ^{226}Ra, 30 Bq/kg for ^{232}Th and 400 Bq/kg for 40K. According to international and national regulation, the annual dose to members of the public, 1 $mSvy^{-1}$ and H_{ex} & H_{in} must be lower than unity. Moreover, no artificial radioactivity was found in the soil samples of this study area. This research concludes that the found values are within the permissible limits as required by the Nuclear Safety and Radiation Control (NSRC) Rules-1997 of Bangladesh and International Atomic Energy Agency (IAEA) Safety Standards- General Safety Requirements (GSR): Part-3.

The result has been published in the Journal of Bangladesh Academy of Sciences, Vol 43 No 2 (2019). pp. 169-180. (Published: 01-03-2020)

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1.22 Measurement of Indoor Radon levels in air using radon detector RAD7

S. Pervin, M. M. M. Siraz, S. Banik, M. S. Rahman and S. Yeasmin

Objective: According to the United States Environ. Protection Agency (USEPA), radon is the second most frequent cause of lung cancer after smoking. If radon gas is inhaled, the ionizing alpha particles emitted by the decay products of ^{218}Po and ^{214}Po can interact with the biological tissue in the lungs leading to DNA damage. Therefore it is necessary to measure radon in air.

Current progress: Indoor radon concentration was measured in eight locations of Atomic Energy Centre, Dhaka campus in the period of Sept. 2018 to Dec. 2018. The assessment was done by using radon detector (RAD7) in which there is a cell of 0.7 liter hemisphere with coating of electrical conductor. For radon concentration determination, radon detector RAD7 uses only Polonium-218 (^{218}Po) and for thoron determination uses only Plonium-216 (^{216}Po) signal. Radon concentration in the studied locations ranged from 28.6±13.0 Bq/m^3 to 125±20.6 Bq/m^3 with an average value of 70.75±26.43 Bq/m^3. The observed indoor radon concentration values were well below the action level recommended by international commission on radiological protection (200-300 Bq/m^3). According to USEPA, the safe limit of radon activity concentration is 148 Bq/m^3. From this measurement, it was observed that the radon activity concentration is within the safe limit in all places. These results will be helpful for further research on variation of radon concentration due to different factors.

1.23 Study of background radiation level in Dhaka city

S. Pervin, M. M. M. Siraz and S. Yeasmin

Objective: To determine any change due to artificial radioactivity releasing from the nuclear installation in case of incident or accident. It is also regulatory prerequisite for the installation and operation of Nuclear Power Reactor.

Current Progress: Measurement of background radiation level has been carried out in Dhaka city from Jan. 2018 to Nov. 2019 on monthly basis. The aim of this study is to assess the external exposure of population due to natural and artificial radiation. Calibrated beta-gamma survey meter and digital survey meter (GAMMA SCOUT) were used for the measurement of dose level where reading was taken by placing the survey meter at a height of 1m from the ground (gonad level). The average background radiation level was found from 0.12 to 0.18 μSv/h for the Year 2018 and 0.11 to 0.17 μSv/h for the Year 2019, respectively. It was observed that there was no change in background radiation level of Dhaka city from the previous study. So these data could be taken as a baseline data.

1.24 Measurement of natural and artificial radionuclides in soil samples collected from Hajigonj, Chandpur district, Bangladesh using HPGe detector

M. Shahabuddin*, S. Pervin, M. M. M. Siraz, K. F. Kakolee* and S. Yeasmin

Objective: To determine the activity concentration of natural and artificial radionuclides in soil samples and its associated health hazards.

Current Progress: Fifteen soil samples were collected from various villages of Hajigonj Upazila in Chandpur District in 2019. Gamma-ray spectrometry system was employed to perform the measurements using a High Purity Germanium (HPGe) detector. The calculated average activity concentrations of ^{238}U, ^{232}Th and ^{40}K in the collected samples were found 24.81±0.040 $Bqkg^{-1}$, 18.97±0.037 $Bqkg^{-1}$and 398.82±0.353 $Bqkg^{-1}$, respectively. The average activity concentration of ^{238}U, ^{232}Th and ^{40}K in the present study is lower than that of the world-wide average value. The estimated average absorbed dose rate (D), the indoor annual effective dose (E_{in}) ,the outdoor annual effective dose (E_{out}), the internal hazard index(H_{in}), the external hazard index (H_{ex}) and the gamma radiation representative level index (I_{γ}) were found as 39.559 $nGyh^{-1}$, 0.194 $mSvy^{-1}$, 0.0485 $mSvy^{-1}$ and 0.2903 $Bqkg^{-1}$, 0.223 $Bqkg^{-1}$, 0.6211 $Bqkg^{-1}$, respectively. The absorbed dose rate and outdoor annual effective dose are lower than that of the International recommended value. There were no artificial radionuclides was found.

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1.25 Investigation of artificial radioactivity concentration in Zinc Oxide compounds samples using gamma spectrometry system

S. Pervin, M. M. M Siraz, N. Hassan and S. Yeasmin

Objective: Health Physics Division (HPD) of Atomic Energy Centre Dhaka (AECD) plays an important role for radiation protection in Bangladesh since its establishment in early sixties. Radiation and radioactivity in Environ. samples and imported/exportable foods (except Chittagong and Mongla Port) are being monitored as per requirement of the Nuclear Safety and Radiation Control (NSRC) Rules -1997 and Bangladesh Atomic Energy Regulatory (BAER) Act-2012.

Current Progress: Artificial radioactivity was measured in sixteen compounds of zinc oxide samples from some exporter company like Bon trade international, All trade international, Huada trade corporation, Eurinco Bangladesh and Building care Technology Ltd. of Bangladesh. All measurement was performed using high purity germanium detector at Health Physics Division, Atomic Energy Centre, Dhaka. The energy of the detector was calibrated using standard source ^{137}Cs. Counting time for each of the sample was 50000 seconds. 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 contamination.

1.26 Determination of ^{137}Cs nuclides in imported foodstuffs samples of Bangladesh using gamma spectrometry system

S. Pervin, M. M .M Siraz, N. Hassan and S. Yeasmin

Objective: Measurements of radioactivity in environment and in foodstuffs are extremely important for controlling radiation levels to which mankind is direct or indirectly exposed. Importation of contaminated food from any region that suffered a nuclear accident can be indirectly affect people health around the world.

Current Progress: Total two thousand seven hundred ninety-eight different kinds of imported and exportable foodstuff samples, were analyzed to detect ^{137}Cs nuclides using a high purity germanium detector in the year 2019. All samples were measured at Health Physic division of Atomic Energy Centre, Dhaka. It was found that the activity concentrations of ^{137}Cs for milk and milk products were below than 95 Bqkg^{-1}which is the permissible limit set by Bangladesh Atomic Energy Regulatory Authority Act-2012. It was observed that except milk and milk products samples for other samples the activity concentration of ^{137}Cs were below than the permissible limit of 50 Bqkg^{-1}according to Bangladesh Atomic Energy Regulatory Authority Act-2012. Therefore no ^{137}Cs nuclides contamination was found within the samples and so the imported and exportable foodstuffs were safe for consumption.

1.27 Determination of gross alpha activity in borehole, potable and drinking water collected from pharmaceuticals company of Bangladesh

S. Pervin, M. M. M. Siraz, M. S. Rahman and S. Yeasmin

Objective: Gross alpha and gross beta measurement is a screening technique for monitoring drinking water supplies for alpha and beta particle activities and thereby determining the necessity for further analysis. No radionuclide specific information can be obtained from this method.

Current Progress: A total of twenty water (borehole, potable and drinking water) sample were collected from six Pharmaceuticals Company of Bangladesh from Jan. 2018 to Dec. 2019 for gross alpha activity measurement. This study was performed using zinc sulfide scintillation detector. The average alpha activity in the borehole water, potable water and drinking water were found 0.008 Bq L-^{1}, 0.0062 Bq L-^{1} and 0.0015Bq L-^{1}, respectively. The alpha activity in the samples are far below the practical screening levels of radioactivity in drinking water of 0.1 Bq L-^{1} for alpha recommended by WHO and therefore may not pose any serious detrimental health side-effects.

1.28 A Study of natural radionuclides in soil samples and associated health hazards in Magura district, Khulna, Bangladesh

M. S. Hassan*, S. Pervin, M. M. M. Siraz, S. Banik, Z. Iqbal* and S. Yeasmin

Objective: To monitor the level of Environ. radiation and radioactivity

Current Progress: The activity concentration of natural and artificial radionuclides is measured in 20 soil samples collected from different union of Magura district by gamma ray spectrometry system which is High Purity Germanium (HPGe) detector. The average activity concentration value of ^{226}Ra, ^{238}U, ^{232}Th and ^{40}K for soil of Magura district is 28.21±3.46 Bqkg^{-1}, 27.76±3.49 Bqkg^{-1}, 29.40 ±4.01 Bqkg^{-1}and 280.29±24.28 Bqkg^{-1} respectively. The highest and lowest absorbed doses (out) rate are 11.20 nGyh^{-1} to 64.42 nGyh^{-1}. The average value 43.61 n Gyh^{-1} is lower than the world average value. The annual average effective dose 0.31 mSv/yr of the samples from Magura district is below the world average value. The highest value of annual effective dose is 0.45 mSv/yr and the lowest value is 0.07 mSv/yr. The Radium Equivalent Activity for Magura district ranges from 22.98 Bq/kg to 137.44 Bq/kg with an average value of 110.01 Bq/kg which is below the world average value. The external hazard index for Magura district ranges from 0.048 mSv/yr to 0.37 mSv/yr with the average external hazard index was found to be 0.24 mSv/yr. Both the external (H_{ex}) and internal (H_{in}) hazard index are less than unity for all the soil samples from Magura district. No artificial radionuclide was found in the samples.

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1.29 Measurement of natural radioactivity and radiological hazard of different paint samples collected from local markets of Bangladesh

A. M. Apon*, S. Pervin, M. M. M. Siraz, S. Banik, M. J. Dewan* and S. Yeasmin

Objective: To measure the level of natural radioactivity and radiological hazard to assure a safe and protected environment.

Current Progress: The activity concentrations of ^{226}Ra, ^{232}Th and ^{40}K were measured in different paint samples Gamma-ray spectroscopy using High purity Germanium (HPGe) detector with 19.6% relative efficiency. A total of twenty paint samples were collected from different local markets of Dhaka city during 7 Dec. to 23 Dec., 2019. All the samples were processed following the standard procedures as per International Atomic Energy Agency (IAEA) guidelines. The work is in progress.

[*]Dept. of Nuclear Engineering, University of Dhaka

2. Seminar/Symposium/Conference/Workshop Attended

Name of the person	Title of the event	Organizer	Date	Place
S. Yeasmin	Workshop on Capacity Building Centres on Emergency Preparedness and Response (CBC)	IAEA	8-11 Jul. 2019	Austria
	2019 ISOE International Symposium on Occupational Exposure Management at Nuclear Facilities, Beijing, China	IAEA	22-24 Oct. 2019	China
	Regional Workshop on Developing a Protection Strategy for a Nuclear or Radiological Emergency	IAEA	25-28 Nov. 2019	Japan
	Conference on Environ. Solutions for Sustainable Development: Towards Developed Bangladesh	Bangladesh Awami League	27-28 Nov. 2019	Press Club, Dhaka
	National Conference on Electronics and Informatics	BES and BAEC	4-5 Dec. 2019	AECD
	3rd International Conference on Physics for Sustainable Development and Technology (ICPSDT-2019	Bangladesh Physical Society	18-19 Dec. 2019	CU
	International Conference on Earth and Environ. Sciences & Technology for Sustainable Development ICEEST-2020	Faculty of Earth and Environ. Science, DU	25-27 Jan. 2020	Inter Continental Hotel, Dhaka
	IAEA-FUKUI Workshop on Communication in Nuclear or Radiological Emergencies	IAEA	17-21 Feb. 2020	Japan
	International conference on Physics in Medicine	BAEC, BMPA & BMPT, DU	6-7 Feb. 2020	DU & AECD
	International conference on Physics	Bangladesh Physical Society	5-7 Mar. 2020	AECD
Dr. M. S. Rahman	Conference on Environ. Solutions for Sustainable Development: Towards Developed Bangladesh	Bangladesh Awami League	27-28 Nov. 2019	Press Club, Dhaka
	National Conference on Electronics and Informatics	BES and BAEC	4-5 Dec. 2019	AECD
	3rd International Conference on Physics for Sustainable Development and Technology (ICPSDT-2019	Bangladesh Physical Society	18-19 Dec. 2019	CU
	International Conference on Earth and Environ. Sciences & Technology for Sustainable Development ICEEST-2020	Faculty of Earth and Environ. Science, DU	25-27 Jan. 2020	Inter Continental Hotel, Dhaka
	International conference on Physics in Medicine	BAEC, BMPA & BMPT, DU	6-7 Feb. 2020	DU & AECD
	International conference on Physics	Bangladesh Physical Society	5-7 Mar. 2020	AECD

Name of the person	Title of the event	Organizer	Date	Place
J. Ferdous	Regional Training Course on Evaluation and Expression of Measurement of Uncertainty for dosimetry	IAEA	22-24 Oct. 2019	Kuwait
Dr. A. K. M. M. Rahman	National Conference on Electronics and Informatics	BES and BAEC	4-5 Dec. 2019	AECD
	International conference on Physics	Bangladesh Physical Society	5-7 Mar. 2020	AECD
M. M. M. Siraz	Instructor Training Course on Environ. Radioactivity Monitoring	JAEA	17Jun.-26 Jul. 2019	Japan
	National Conference on Electronics and Informatics	BES and BAEC	4-5 Dec. 2019	AECD
	3rd International Conference on "Physics for Sustainable Development and Technology (ICPSDT-2019)",	Dept. of Physics, CUET	18-19 Dec. 2019	CUET
	International Conference on Earth and Environ. Sciences & Technology for Sustainable Development ICEEST-2020	Faculty of Earth and Environ. Science, DU	25-27 Jan. 2020	Inter Continental Hotel, Dhaka
	International Conference on Physics in Medicine	BAEC, BMPA & BMPT, DU	6-7 Feb. 2020	DU & AECD
	International conference on Physics	Bangladesh Physical Society	5-7 Mar. 2020	AECD
S. Pervin	National Conference on Electronics and Informatics	BES and BAEC	4-5 Dec. 2019	AECD
	3rd International Conference on Physics for Sustainable Development & Technology (ICPSDT2019)	Dept. of Physics, CUET	18-19 Dec. 2019	CUET
	International Conference on Earth and Environ. Sciences& Technology for Sustainable Development (ICEEST) 2020	Faculty of Earth and Environ. Sciences, DU	25-30 Jan. 2020	Inter Continental Hotel, Dhaka
	International conference on Physics in Medicine	BAEC, BMPA & BMPT, DU	6-7 Feb. 2020	DU & AECD
	International conference on Physics	Bangladesh Physical Society	5-7 Mar. 2020	AECD
N. Hassan	National Conference on Electronics and Informatics	BES and BAEC	4-5 Dec. 2019	AECD
	International conference on Physics	Bangladesh Physical Society	5-7 Mar. 2020	AECD
	A Follow-up Training Course on Reactor Engineering-2020	BAEC and JAEA	09-27 Feb. 2020	TI, AERE
S. Banik	IAEA/RCA Regional Training Course on Gamma-Ray Spectrometry	IAEA	26 Aug.-06 Sept. 2019	ANSTO Australia
	MEXT The Nuclear Researchers Exchange Program-FY2019	MEXT	30 Sept. 2019- 28 Feb. 2020	Hirosaki University Japan

3. Training Course Organized and Seminar Arranged

Title	Date	Place	No. of participants
8th Follow-up Training Course entitled Environ. Radioactivity Monitoring Course at BAEC (ERMCB-8)-2020	12-16 Jan. 2020	TI, AERE	26

4. Collaboration Work

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

- IAEA/TC project BGD/9/015- Strengthening National Capacity build-up for the protection of workers Exposed to ionizing Radiation and public
- RAS/9/080- Enhancing National Capabilities on Occupational Radiation Protection in Compliance with Requirements of the New International Basic Safety Standards
- Special Research Allocation Project: "Radiation Monitoring and Evaluation of Radiation Risk to Public around Large Hospitals in Dhaka city"
- Lectur delivered for M. Phil students in Nuclear Medicine, Part-I students of Bangabandhu Sheikh Mujib Medical University
- Lectur delivered for A sessional course of level-2, term-1, Dept. of Nuclear Science and Engineering, Military Institute of Science and Technology (MIST)
- Question preparation, moderation of the question and evaluation of the Exam. paper on Basic Physics part-I, paper-III of M. Phil (Nuclear Medicine) examination.

5. Services Rendered

5.1 Radioactivity Testing of Imported and Exportable Food Items

During the reporting period, 2336 imported milk & milk products samples & other samples and exportable samples were tested in this division. The radioactivity level of ^{137}Cs in all the samples was within the limit as per Nuclear Safety and Radiation Control Rules 1997.

Name of the month	Milk & milk products (A)	Others (B)	Imported C = A+B	Domestic product	Individual product	Total
Jul. 2019	57	110	167	1	13	181
Aug. 2019	20	129	149	2	6	157
Sept. 2019	82	143	225		16	241
Oct. 2019	52	150	202		34	236
Nov. 2019	69	194	264		28	291
Dec. 2019	35	122	157		23	180
Jan. 2020	22	179	201		58	259
Feb. 2020	34	52250	284		55	339
Mar. 2020	28	199	227	1	39	266
Apr. 2020	45	28	73	5		73
May 2020	36	38	74			74
Jun. 2020	16	23	39	1		39
Grand Total						2336

5.2 Gross Alpha and Gross Beta Measurement

	Type of sample	No. of sample	Total parameters
Square Pharmaceuticals Ltd. (Dhaka unit)	Bore Hole water	5	1
Beximco Pharmaceuticals Ltd. (Dhaka unit)	Portable water	4	2
SK-F Pharmaceuticals Ltd. (BD)	Portable water	6	3
ACI Pharmaceuticals Ltd. (Dhaka unit)	Portable water	6	1
Karnofully Fertilizer Company Ltd. Chittagong	Water	1	1
Grand Total		22	8

5.3 TLD Badges Issue

During the reporting period (Jul. 2019-Jun. 2020), 548 new TLD badges have been issued to radiation workers of 222 new organizations which are shown in Table-3.

Name of the month	No. of new organizations	No. of new workers
Jul. 2019	25	70
Aug. 2019	17	27
Sept. 2019	30	51
Oct. 2019	24	90
Nov. 2019	27	67
Dec. 2019	36	52
Jan. 2020	25	83
Feb. 2020	26	80
Mar. 2020	12	28
Apr. 2020	-	-
May 2020	-	-
Jun. 2020	-	-
Total	222	548

5.4 Dose Measurement and Reporting

During the reporting period, doses of 9687 TLD badges of 3220 organizations were measured quarterly. Evaluated values of effective doses were recorded in the database system and reported to the relevant organizations. Table 4 shows month wise number of dose measured TLD badges of radiation workers working in different organizations.

Name of the month	Number of organizations	Number of measured TLD badges
Jul. 2019	446	1335
Aug. 2019	261	747
Sept. 2019	309	827
Oct. 2019	439	1330
Nov. 2019	346	1232
Dec. 2019	404	1129
Jan. 2020	368	924
Feb. 2020	325	966
Mar. 2020	254	956
Apr. 2020	-	-
May 2020	20	59
Jun. 2020	48	182
Total	3220	9687

5.5 Individual Radiation Monitoring

This division, the only individual radiation monitoring service provider in Bangladesh, has been providing service all over the country to the occupational workers who have been working in the different radiation fields such as medicine, industry, agriculture, education and research. Till 9th June 2020, the total number of organizations and radiation workers came under this service was 4537 and 9878 respectively.

Practices	No. of organizations	No. of radiation workers
Radiotherapy	13	364
Nuclear Medicine	18	489
Industrial Radiography	39	252
Diagnostic Radiology	4326	7794
Research	19	376
Others (Quality Control, Level Gauge etc)	122	603
Total	4537	9878

Materials Science Division, AECD

Objective

Materials Science Division, Atomic Energy Centre, Dhaka carries out research in bulk and nano structural applications oriented materials, which have potential use in the different branches of i.e. nanotechnology, telecommunication, information technology and biotechnology. The division is involved with both synthesis and characterization of different kind of materials. Divisional activity is further enriched by an ADP project, "Development of the Infrastructure for the Capacity Build up of Nano and Nano and biomedical Laboratories at Materials Science Division, Atomic Energy Centre, Dhaka". The divisional activity is further enriched by an international collaboration Program of BAN-02, International Science Program, Uppsala University, Sweden. MSD accomplished exhaustive research in the nanocomposite magnetic alloy systems which have potential applications in the miniaturization of electrical and electronic components. Crystallographic characterization and quantitative phase study of inorganic, organic, thin film and unknown materials are carried out by XRD and SEM. Large numbers of students are involved with this group through different academic programs from various public and private universities under national and international collaboration. The division also provides supports and services to the industrial and research organizations.

Program

- Research and development works of this division are as follows: Development of spinel type soft ferrites using magnetite and commercial grade raw materials and study of their characteristic properties
- Synthesize, characterization and study of the biomedical application of nanometric scale ferrite/dielectric materials
- Development of ferrite permanent magnets from beach sand mineral 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
- Crystallographic characterization and quantitative phase study of inorganic, organic, thin film and unknown materials by XRD method
- In-situ high temperature phase transition study of binary alloys
- 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 Chitosan, ZrO_2, Al_2O_3…etc ceramic materials for biomedical Application
- Preparation of functionalized Carbone nanotube Applications
- Synthesis of Graphine Oxide and Reducel and its appilicationd Graphoine Oxide.

Activities

1. Research and Development Work(s)

1.1 Study of structural and magnetic properties of superparamagnetic and ferromagnetic iron based nanoparticles for cancer treatment

S. M. Hoque, S. I, Liba, A. Nahar, A. Parveen, A. A. Begum, K. Hasan, N. Begum and S. Nasrin*

Objective: The objective of the work is to Study of Structural and Magnetic Properties of Superparamagnetic and Ferromagnetic Iron Based Nanoparticles for Cancer Treatment

Current progress: The initiation of ferrite nanoparticles has changed the perception of nanotechnology in the biomedical field especially magnetic hyperthermia based application for cancer treatment. Researchers synthesize new materials that can be successfully used for the biomedical application. Wet chemical co-precipitation method has been used to synthesize chitosan-coated $Co_{1-x}Mn_xFe_2O_4$ ($0.2 \leq x \leq 1.0$, in the steps of 0.2) and $Co_{1-x}Zn_xFe_2O_4$ ($0.2 \leq x \leq 0.8$, in the steps of 0.2) nano ferrites. Face-centered cubic structure of the nano ferrites has been revealed by XRD anslysis. From the XRD data, the lattice constant, ionic radii and bond lengths at tetrahedral sites and octahedral sites were estimated. The analysis revealed that the hoping lengths at tetrahedral and octahedral sites are increased for Co-Zn and Co-Mn Ferrites with the addition of divalent ion. Surface morphology was investigated by TEM, HRTEM and SAED image for coated samples. Homogeneous structure was observed for all the coated samples. The FESEM has shown that the ferrite nanoparticles are agglomerated in the powder sample for all the samples. EDAX studies revealed the elemental distribution of both bare and coated ferrite nanoparticles. The presence of absorption bands were confirmed for all coated samples by FTIR spectra. The magnetic characterization has been done by VSM. Heating of the nanoparticles is dependent on hysteresis loss that is related to the area of the hysteresis loop. In agreement with magnetization data, there shows a transition from ferromagnetic to paramagnetic behavior has observed by Mossbaur spectra. From Mossbaur spectra, values of isomer shift, quadrupole splitting and syperfine field have been measured. Hydrodynamic diameter and polydispersity index (PDI) of all coated samples have been found in the limits that the samples can be uses for biochemical applications. By comparing all the cytotoxicity data on Hela cell line, it is observed that the survival of cells was around 75%-90% for all te ferrites sample. Relaxivity values were calculated from MRI image. With the increase of divalent ion, the value of relaxivities gradually decreases. Hyperthermia temperature of all coated ferrite samples have been measured. From steep slope of time dependence temperature graph, the value of Specific Loss Power (SLP) has been also calculated.

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1.2 Cultivation and identification of rat`s bone marrow cell inside the 3D porous network synthesized hydroxyapatite-chitosen-gelatin basied scaffold

S. M. Hoque, S. I. Liba, A. Nahar, A. A. Begum, K. H. Fakir, N. Begum and K. Mohuna*

Objective: The objective of the work is to Cultivation and Identification of Rat`s Bone Marrow Cell inside the 3D Porous Network Synthesized Hydroxyapatite-Chitosen-Gelatin Basied Scaffold

Current Progress: Bones constructed by tissue engineering is emerging as an important tool for the reparing of large defects in natural bone. Rat`s bone marrow cells differentiated into multilineage cells when cultured with specific growth factors. The surface features and porosity of used materials in culture affects cell growth and maintain bone mineral organization. The effect of prepared hydroxyapatite ($Ca_{10}(PO_4)_6(OH)_2$) and scaffolds for the adhesion, differentiation and proliferation on extracted rat`s bone marrow cell have studied. Furthermore, wet chemical precipitation method was used for hydroxyapatite preparation. Calcium nitrate-tetrahydrate and di-ammonium hydrogen phosphate were used to prepare hydroxyapatite. The bone like matrix formation of hydroxyapatite-Chitosan-gelatin based composite scaffold was prepared through freeze drying technique. Here, glutaraldehyde was used which acted as a cross-linker during preparation of scaffold. Crystal structure of hydroxyapatite was estimated using peak pattern of X-ray diffraction (XRD). Formation of hydroxyapatite and hydroxyapatite-chitosan-gelatin based scaffold were identified by Forier transform infrared spectroscopy (FTIR). Transmission electron microscopy (TEM) accomplished the shape of hydroxyapatite is needle-like. Thermo Gravimetric Analysis (TGA) also have been carried out to check thermal stability. Scanning Electron Microscopy (SEM) reveals the creation of a good interlinked porous

scaffold having a pore size in between 40-500 µm which is ood for tissue growth and performing osteo-induction and osteo-integration. Cytotoxicity measurement claimed that the prepared hydroxyapatite and scaffolds are non toxic. Raman spectroscopy of prepared scaffold is mostly similar with femoral mouse bone. Necessary cell cultivation through Raman spectroscopy of prepared scaffolds is mostly similar with femoral mouse bone. Necessary cells were extracted from a rat femur and tibia-fibula. Those cells have attached with scaffolds at the time of incubation. Surface image of scaffold was taken before and after of cell cultivation through Raman spectrometer. Cells growth was observed through hemocytometer. It was revealed that number of cells have become approximately twice after using hydroxyapatite and scaffold. Bone marrow cell cultivation with prepared porous scaffold can be capable to create new dimension for bone regeneration and restoration in bio-medical field.

*Dept. of Physics, University of Dhaka

1.3 Study of physical properties towards optimizing sintering temperature of Y-substituted

S. M. Hoque, M. N. I. Khan, A. Nahar, A. A. Begum, K. H. Fakir, N. Begum and A. Ali*

Objective: The objective of the work is to Study of Physical properties towards optimizing sintering temperature of Y-substituted.

Current progress: Optimum sintering temperature (Ts) plays an important role in controlling densification and growth of grains which greatly affect the magnetic and electrical properties of polycrystalline materials. Y-substituted Mg-Zn [Mg0.5Zn0.5YxFe2-xO4 (0≤x≤0.05)] ferrites have been prepared by using conventional standard ceramic technique and were sintered between 1100 to 1300 °C in the steps of 50 °C. Characterizations of the samples have been done by X-ray diffraction (XRD) technique, field emission scanning electron microscopy (FESEM), dielectric and permeability measurements to find the suitable Ts. XRD data have been analyzed and the results confirmed the same information regarding phase analysis at different Ts. Further characterization of the samples, sintered at 1100 and 1150 °C, were not continued due to their low density and high porosity. FESEM images indicate the change in microstructure with Ts. The decrease (increase) of ac electrical resistivity with Ts (Y content) has been observed while the dielectric constant behaves in opposite manner. Impedance spectroscopy also exhibited similar trend as ac electrical resistivity. The initial permeability revealed the wide stability zone of frequency and different optimum Ts for different compositions. The ac resistivity values for the compositions have been found higher at 1200 °C, but the compositions have highest value of bulk density and permeability at other Ts. The effect of Ts on the physical properties (bulk density, porosity and permeability) of Y-substituted Mg0.5Zn0.5YxFe2-xO4 (0≤x≤ 0.05) ferrites elucidate that the optimum Ts should be of 1250 °C for x = 0.01, 0.02 and 0.03 while the Ts should be of 1300 °C for x = 0.04 and 0.05.

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1.4 Yttrium-substituted Mg-Zn ferrites: correlation of physical properties with Yttrium content

S. M. Hoque, M. N. I. Khan, S. I, Liba, A. Nahar, A. Parveen, A. A. Begum, K. H. Fakir, N. Begum and M. A. Alil*

Objective: The objective of the work is to Yttrium-substituted Mg-Zn ferrites: correlation of physical properties with Yttrium content

Current progress: Yttrium- (Y) substituted Mg-Zn ferrites with the compositions of $Mg_{0.5}Zn_{0.5}Y_xFe_{2-x}O_4$ ($0 \le x \le 0.05$) have been synthesized by conventional standard ceramic technique. The effect of Y^{3+} substitution on the structural, electrical, dielectric and magnetic properties of Mg-Zn ferrites has been studied. The single phase of spinel structure with a very tiny secondary phase of $YFeO_3$ for higher Y contents has been detected. The theoretically estimated lattice constant has been compared with measured experimental lattice constant. The bulk density, X-ray density and porosity have been calculated. The Energy Dispersive X-ray Spectroscopy (EDS) study confirms the presence of Mg, Zn, Y, Fe and O ions in the prepared samples. Frequency dependence of conductivity has been studied and an increase in resistivity (an order) has been observed. Frequency dependence of dielectric constant (ε), dielectric loss tangent ($\tan\delta$) has been studied and the lowering of ε with the increase of Y content was noted. Dielectric relaxation time was found to vary between 15 to 31 ns. The saturation magnetization (M_s), coercive field (H_c), remanent magnetization (M_r) and Bohr magneton (μ_B) have been calculated. The variation of M_s has been successfully explained with the variation of A-B interaction strength due to Y substitution. The soft ferromagnetic nature also confirmed from

the values of H_c. The complex permeability has been studied and the initial permeability was found to increase with Y up to $x = 0.01$, thereafter it decreases. The values of electrical resistivity and dielectric constant with proper magnetic properties suggest the suitability of Y-substituted Mg-Zn ferrites in microwave device applications.

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1.5 Optical and electrical properties of crystalline indium tin oxide thin deposited by vacuum evaporation technique

S. M. Hoque, M. N. I. Khan S. I, Liba, A. Nahar, A. A. Begum, K. H. Fakir, N. Begum and M.M.M. Hosen*

Objective: The objective of the work is to optical and electrical properties of crystalline indium tin oxide thin deposited by vacuum evaporation technique

Current progress: Indium tin oxide (ITO) thin film was deposited on glass substrate by means of vacuum evaporation technique and annealed at 200 °C, 300 °C and 400 °C in air for 1 h. The characterization and properties of the deposited film samples were analyzed by X-ray diffraction (XRD), scanning electron microscopy (SEM) and UV-VIS-NIR spectroscopy techniques. From the XRD patterns, it was found that the deposited thin film was of crystalline at an annealing temperature of 400 °C. The crystalline phase was indexed as cubic structure with lattice constant and crystallite size of 0.511 nm and 40 nm, respectively. The SEM images showed that the films exhibited uniform surface morphology with well-defined spherical grains. The optical transmittance of ITO thin film annealed at 400 °C was improved from 44% to 84% in the wavelength range from 250 nm to 2 100 nm and an optical band gap was measured as 3.86 eV. Hall effect measurement was used to measure the resistivity and conductivity of the prepared film.

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1.6 Biocomposites of synthetic polymer modified microcrystalline jute cellulose particles and their hemolytic behavior

S.M. Hoque, S. I. Liba, A. Nahar, A. Parveen, A. A. Begum, K. H. Fakir, N. Begum and M. A. Rabbi*

Objective: The objective of the work is to Biocomposites of synthetic polymer modified microcrystalline jute cellulose particles and their hemolytic behavior

Current progress: Natural jute fiber can be used as a good source of biocomposite for application in biomedical field. Here microcrystalline jute cellulose (MCJC) particles were first prepared by the hydrolysis of bleached jute pulp with H_2SO_4 and the effect of acid strength was examined. A maximum crystallinity index of 89% was found for MCJC particles prepared by hydrolysis with 30% H_2SO_4. The surface of MCJC particles possessing the highest crystallinity index was then modified with various synthetic polymers like poly (2-hydroxyethyl methacrylate) (PHEMA), poly (glycidyl methacrylate) (PGMA) and poly (lauryl methacrylate-methyl methacrylate) P(LMA-MMA) via in situ seeded free radical polymerization. The values of crystallinity index decreased to 74, 66 and 76% in MCJC/PHEMA, MCJC/PGMA and MCJC/P(LMA-MMA) composite particles respectively. The adsorption magnitudes of biomolecules on composites were relatively high compared to those on MCJC particles. Lower hemolytic activities ($< 1.0\%$) confirmed the biocompatible nature of composite particles, a requisite property for any composite desired for efficient biorelated applications.

*Dept. of Applied Chemistry & Chemical Engineering, University of Dhaka

1.7 Tailoring the properties of Ni-Zn_cum ferrites by Gd^{3+} substitution

S. M. Hoque, M. N. I. Khan, S. I. Liba, A. Nahar, A. Parveen, A. A. Begum, K. Hasan, N. Begum and M.D. Hossain*

Objective: The objective of the work is to Tailoring the properties of Ni-Zn_Cum ferrites by Gd^{3+} substitution

Current progress: Structural, magnetic and electrical properties of Ni0.7Zn0.2Co0.1Fe2-xGdxO4 (x = 0.00, 0.02, 0.05, 0.07, 0.1 and 0.12) ferrites, prepared by the standard solid-state reaction technique have been studied. The single phase of cubic spinel structure was confirmed by X-ray diffraction, lattice constant, bulk density and porosity were calculated. The FE-SEM examined the surface morphology of the prepared

samples. Real and imaginary parts of the complex permeability and magnetic properties of the samples were measured using Impedance Analyzer and VSM respectively. Initial permeability decreases with increasing of Gd content up to x = 0.05 and then increases with Gd. The dielectric constant and dielectric loss tangent of the studied samples decreased with the increase of Gd concentration. The eddy current loss of the prepared samples is expected to decrease with the increase of Gd content due to increase in ac resistivity. Complex impedance plots were studied to understand the contribution of grains and grain boundary resistances. span.

*Dept. of Nuclear Engineering, University of Dhaka

1.8 Enhancement of effective accumulation of atoms during fabrication of Al microsphere

S. M. Hoque, S. I. Liba, A. Nahar, A. Parveen, A. A. Begum, K. Hasan, N. Begum and F. Kamal*

Objective: The objective of the work is to Enhancement of Effective Accumulation of Atoms during Fabrication of Al Microsphere

Current progress: Microspheres of Al have been successfully fabricated utilizing electromigra-tion using sudden change in geometrical shape of a specimen. The experi-mental sample was a passivated Al line with a hole at the transitional area of the sample. The hole was used to control the accumulation and discharge process. The formation of the microsphere is enhanced by controlling tem-perature and current density. The atomic flux was increased with the in-creasing current density that was happened along the electron flow direction in the small region at the geometrical shape of the samp

*Dept. of Materials Science division, AECD

1.9 Investigation of tornado and hurricane generated missile impact load on the safety-related nuclear reactor support structures in Canada

F. M. Kamal, M. M. Haque, M. N. I. Khan, 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, N. Begum, A. Hossain, M. N. Islam, Z. Begum, M. A. Kayum, M. A. Rahman and F. M. Kamal*

Objective: The objective of the work is to Study of the Investigation of Tornado And Hurricane Generated Missile Impact Load on the Safety-Related Nuclear Reactor Support Structures in Canada

Current progress: We reported here, the pH dependence manganese ferrite ($MnFe_2O_4$) nanoparticles were synthesized using chemical co-precipitation method and characterized by XRD, TEM, EDX and VSM to determine different properties of nanoparticles which will focus on the preparation technique and it will also provide an overview of the structural and magnetic properties of manganese spinel ferrites. The XRD results obtained of manganese ferrite nanoparticles showed the formation of manganese ferrite nanoparticles with an average particle sizes are in good agreement with previous reported experiment results and displayed good magnetic properties. The crystalline sizes and lattice parameters from XRD results are 5nm to 15 nm and 8.43Å to 8.50Å where EDX results are suitable for all samples. The maximum magnetizations are 8 emu/gmto 18 emu/gm during applied field 2 Tesla. The Mossbauer results confirmed the doublet pattern and superparamagnetic in nature of these samples. The FTIR study obtained as the octahedral and tetrahedral position of all samples and confirmed the suitability of coating condition as compared to the previous standard data.

*Dept. of Materials Science Division, AECD

1.10 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.M. Hoque, M. N. I. Khan, H. N. Das, R. Rashid, M. R. Hasan, A. A. Begum, K. H. Fakir, A. Hossain, Z. Begum, N. Begum and U.H. Tanni*

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. In this study 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. The saturation magnetization is found to be in good agreement with reported values and are lowed with

*Dept. of Physics, University of Cumilla

1.11 Synthesis and magneto electric characterization of Sr-substituted Ni-Zn ferrites

F. M. Kamal, S. M. Hoque, M. N. I. Khan, H. N. Das, R. Rashid, M. R. Hasan, A. A. Begum, K. Hasan, A. Hossain, Z. Begum, N. Begum and A. T. Trina*

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 wheras 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 saturation magnetization is found to decrease with Sr content which is attributed to Neel`s two sub-lattice model of ferrites. The observed variation in Ms can be explained in terms of cation redistribution between A- and B- sublattices. Magnetic hysteresis is investigated at room temperature. All the samples exhibited lower coercivity values indicating that the materials belong to the class of soft ferrites. The real permeability of the samples remains almost constant up to a certain frequency and then falls rapidly. The dielectric constant decreases with increasing frequency exhibiting normal dielectric behavior of ferrites. Room temperature AC resistivity of the samples shows the significant dispersion with frequency. The electrical conduction in these ferrite is explained on the basis of the hopping mechanism between the Fe^{2+} and Fe^{3+} ions on octahedral B-sites.

*Dept. of Physics, University of Cumilla

1.12 Synthesis and chracterization of Y and Sn ions substituted Mg-Zn ferrites

M. N. I. Khan, S. M. Hoque, F.M. Kamal, S. I, Liba, A. Parveen, A. A. Begum, K. Islam, N. Nahar and M. A. Ali*

Objective: The objective of the work is to the Study of the Synthesis and Chracterization of Y and Sn ions substituted Mg-Zn ferrites

Current progress: We have investigated the effect of Y^{3+} ($0 \leq x \leq 0.05$; in a step of 0.01) and Sn^{4+} ($0 \leq x \leq 0.10$; in a step of 0.02) ions substitution in the Mg-Zn ferrites ($Mg_{0.5}Zn_{0.5}(Y/Sn)_xFe_{2-x}O_4$) prepared by conventional ceramic technique. The samples have been characterized by considering XRD analysis, FESEM measurement, FTIR spectra, UV-Vis results, quantum design PPMS and impedance analyzer measurement. Optimum sintering temperature has been measured for both series (1250°C for Y substituted compositions and 1200°C for Sn compositions) by considering the XRD pattern, bulk density, porosity, microstructure and permeability. The single phase of spinel structure with a secondary phase of $YFeO_3$ and SnO_2 has been detected for higher Y ($x \geq 0.04$) and Sn ($x = 0.10$) contents, respectively. The bulk density, X-ray density and porosity have been calculated. The FESEM images confirm the significant effect in microstructure due to Y and Sn substitutions. The Energy Dispersive spectra study confirmed the presence Mg, Zn, Y/Sn, Fe and O ions in the prepared samples. Mechanical stability of all studied compositions is confirmed from the stiffness constant (C_{ij}) using Born stability conditions. Brittleness nature is also confirmed using Poisson's ratio. The DC and AC resistivity (dielectric constant) increases (decreases) due to Y substitution and decreases

(increases) due to Sn substitution. The energy band gap has been calculated from the UV-Vis. The saturation magnetization, coercive field, remanent magnetization and Bohr magneton have also been calculated. The variation of M_s has been successfully explained with the variation of A-B interaction strength due to Y and Sn substitution. The soft ferromagnetic nature of the compositions has also been confirmed from the values of H_c. The T_c has been measured from temperature dependent magnetic moment (M-T) and initial permeability (μ'_i-T) measurement and the obtained values are found to be in good agreement with each other. Decrease in T_c with Y and Sn content is due to redistribution of cations and weakening of the exchange coupling constant. The magnetic phase transition has been analyzed by Arrott plot and found to be second order in nature. The complex permeability has been studied and wide zone of utility has also been confirmed. The initial permeability is found to be increased with Y for x=0.01, thereafter it decreases while the Sn substitution shows decreasing trend. The values of electrical resistivity and dielectric constant with proper magnetic properties suggest the suitability of Y and Sn substituted Mg-Zn ferrites in microwave device applications.

*Dept of Physics, Chittagong University of Engineering and Technology

1.13 Synthesis and analysis of the influence of Eu^{3+} on the structural, ferromagnetic, dielectric and conductive characteristics of $Ni_{0.4}Zn_{0.45}Cu_{0.15}Fe_{(2-x)}Eu_xO_4$ composites using conventional double sintering ceramic method

M. N. I. Khan, S.M. Hoque, F.M. Kamal, S. I, Liba, A. Parveen, A. A. Begum, K. Islam, N. Nahar and S. Khatun*

Objective: The objective of the work is to the Study of the Synthesis and analysis of the influence of Eu^{3+} on the structural, ferromagnetic, dielectric and conductive characteristics of $Ni_{0.4}Zn_{0.45}Cu_{0.15}Fe_{(2-x)}Eu_xO_4$ composites using conventional double sintering ceramic method

Current progress: Conventional double sintering ceramic method has been followed to prepare a series of Eu substituted $Ni_{0.4}Zn_{0.45}Cu_{0.15}Fe_{(2-x)}Eu_xO_4$ ferrites with x = 0.00, 0.02, 0.04, 0.07, 0.10, 0.12, 0.15. XRD peaks confirm the single phase cubic spinel structures of all the samples. The lattice parameter is found to be distorted with the addition of Eu into the samples. X-ray density and bulk density increase with the increase of Eu content. Better crystallization has been obtained with the decreasing porosity as a result of increasing Eu^{3+} concentration. The dielectric constant of the samples shows a decreasing trend while both AC and DC resistivities are observed to increase with the increase of Eu^{3+} concentration. The high resistivity offers greater value of the activation energy. Permeability is found to decrease with increasing Eu content. Saturation magnetization changed significantly with Eu^{3+} concentration. Noteworthy decrease of the Curie temperature is observed with the addition of Eu substituent.

*Dept of Physics, Jagannath University

1.14 Influence of total absorbed dose of Co-60γ-radiation on theproperties of h-MoO_3thin films

M. N. I. Khan, S.M. Hoque, F.M. Kamal, A. Nahar, A. Parveen, A. A. Begum, K. Islam, N. Nahar and S. K. Sen*

Objective: The main objective of the work is to Influence of total absorbed dose of Co-60γ-radiation on theproperties of h-MoO_3thin films

Current progress: Optoelectronic and photonic devices are confronted with challenges imposed by extreme Environ. conditions encountered in applications such as space satellite, nuclear radiation environment, etc. High energy radiations may alter the physical characteristics of these devices. In this context, studying the effect of gamma (γ-) radiation on relevant semiconductor thin films for devices is of paramount importance to ensure its optimum performances. In this research, the effect of high energy γ-radiation (with doses 50 kGy, 150 kGy and 250 kGy) on the properties of hexagonal molybdenum trioxide (h-MoO_3) thin films was thoroughly investigated. The enhanced crystallinity of the as-synthesized thin films was observed due to the reduction of defects and disorders. Interestingly, the identified hexagonal phase of the pristine film remained identical after high dose irradiation. Field Emission Scanning Electron Microscopy (FESEM) revealed no significant changes in surface morphologies of the films after irradiation. Fourier transforms infrared (FTIR) spectra confirmed the hexagonal structure of MoO_3 films evidently before and after irradiation, although the peak intensities and wavenumbers were found to vary slightly. With increasing γ-irradiation the band gap was shown to reduce from 2.92 to 2.84 eV as measured by UV-Vis-NIR diffuse reflectance spectrophotometer. The γ-irradiation has displayed a significant improvement in the degree of crystallinity and reduced the optical band gap without transforming the hexagonal phase of pristine nanocrystalline h-MoO_3 film.

*Dept. of Physics Chittagong University of Engineering and Technology

1.15 Neutron imaging and tomography with Medipix2 and dental Microroentagenography: an overview

M. N. I. Khan, S.M. Hoque, F.M. Kamal, A. Nahar, A. Parveen, A. A. Begum, K. Islam, N. Nahar and M. N. I. Khan*

Objective: The objective of the work is to the Study of the Neutron Imaging and Tomography with Medipix2 and Dental Microroentagenography: An Overview

Current progress: An over view of Neutron Imaging and Tomography (NIT) with Medipix2 and Dental Micro-roentgenography have been presented in this article. This over view confined to semiconductor detector Medipix2, neutron radiography and tomography and dental microroentgenography. Medipix2 is a pixel-based detector technology employed to measure charge particles, photons (visible through gammas) and neutron. Neutron Beam for this technology are LVR-15 Research Reactor (107 n/cm2 s) and Spallation neutron source ($3\times106 n/cm^2$ s). This technology has been verified with photograph and neutronogram of a relay and photograph and tomographic 3D reconstruction of a bullet cartidge, tooth and fishing thread. Comparison of spatial resolution among different imagers also has been presented.

*Dept. of Materials Science, AECD

1.16 Frequency and temperature dependent magnetic properties with structural rietveld refinement of $Co_{0.25}Zn_{0.75}Y_xFe_{2-x}O_4$ ferrites

M. N. I. Khan, S.M. Hoque, F.M. Kamal, H.N. Das, A. Parveen, A. A. Begum, K. Islam, N. Nahar and M. D. Hassan*

Objective: The objective of the work is to Frequency and temperature dependent magnetic properties with structural Rietveld refinement of $Co_{0.25}Zn_{0.75}Y_xFe_{2-x}O_4$ ferrites

Current progress: Doping of rare earth ions can influence the magnetic properties in spinel ferrites, whereas the phase formation plays an important role. Therefore, it is important to choose the RE ions for doping content to get more benefit. In this work, synthesis of Yttrium doped Co-Zn ferrites were carried out by the method of solid state reaction. $Co_{0.25}Zn_{0.75}Y_xFe_{2-x}O_4$ is the general formula of the studied ferrites where x = 0.00, 0.02, 0.04, 0.06 and 0.08. The structural properties of CZYF ferrites were studied by XRD technique and further refined by Rietveld method. XRD and Rietveld refinement approved that all the CZYF samples are cubic spinel structure and the lattice parameters were increased with increasing Y content. The variation of grain growth and surface morphology of CZYF samples were studied from SEM images indicated that the average grain size increased from 1.412 μm to 2.341 μm. Frequency dependent magnetic properties were observed in the range of 100 Hz to 120 MHz at 300 K (room temperature). The initial permeability of CZYF ferrites are found to decrease with the increase in Y content. This decrease nature of permeability is related to the increase of porosity and average grain size. At three different temperatures (80 K, 200 K and 300 K), we measured saturation magnetization, coercivity and remanent magnetization. The mentioned properties make CZYF ferrites applicable for use as a soft ferrite.

*Dept. of Physics, University of Dhaka

1.17 Synthesis of cobalt ferrite-reduced graphene oxide nanocomposite as magnetic adsorbent for textile dye removal

M. A. Mamun, S. M. Hoque, M. M. Haque, A. Parveen, Z. Begum and G. C. Mallick*

Objective: The objective of the work is to Synthesis of cobalt ferrite-reduced graphene Oxide nanocomposite as magnetic adsorbent for textile dye removal

Current progress: Water contamination with textile dyes is an escalating problem, despite the huge research efforts put in the field of water treatment. The paper reports on the synthesis of cobalt ferrite-reduced graphene oxide ($CoFe_2O_4$-RGO) nanocomposite by hydrothermal method. The nanocomposite material has been characterized using various analytical techniques, including XRD, SEM, FTIR spectroscopy, Raman spectroscopy, TGA and VSM to demonstrate the successful attachment of cobalt ferrite nanoparticles to reduced graphene oxide sheets. The synthesis and characterization process was carried out at MSD, AECD, BAEC. The cubic spinel structure of prepared $CoFe_2O_4$ nanomaterials was confirmed from the diffraction patterns. The distribution of $CoFe_2O_4$ nanoparticles on RGO sheets was confirmed from the SEM micrographs. The reduction of graphene oxideand the composite formation of $CoFe_2O_4$ nanostructures with

RGO sheets was explored byusing Raman spectroscopy and FTIR spectroscopy. The magnetic behavior of $CoFe_2O_4$-RGO nanocomposite was analyzed through the hysteresis loop. There are many functional groups in RGO which can make the composite suitable for dye removal purpose.

*Dept. of Physics, Science Engineering and Technology School, Khulna University

1.18 Effect of sintering treatment on the microstructure of $NiFe_2O_4$ synthesized by the sonochemical and the conventional method

M. N. I. Khan, S. M. Hoque, F. M. Kamal, H. N. Das, A. Parveen, A. A. Begum, K. Islam, N. Nahar and S. Liba*

Objective: The objective of the work is to Effect of sintering treatment on the microstructure of $NiFe_2O_4$ synthesized by the sonochemical and the conventional method

Current progress: Nickel ferrite ultrafine nanoparticles were synthesized by the sonochemical method. The sample was sintered at temperatures ranging from 1273 K to 1673 K for 3 h. XRD peaks of as-synthesized $NiFe_2O_4$, their TEM, high resolution TEM and selective area (electron) diffraction pattern demonstrate that the particles are in the completely crystalline state. The initial particle size of as-synthesized $NiFe_2O_4$ was found to be approximately <5 nm. Besides, $NiFe_2O_4$ samples were also synthesized by a conventional double sintering technique. The purpose was to compare the effect of sintering treatment on the microstructure quality of the $NiFe_2O_4$ prepared by these two techniques. Homogeneous coaxial grains did not form until 1573 K for conventionally prepared samples, while for the sonochemical method, homogeneous grains started to form even as low as 1373 K. Furthermore, other measurements were done only for the sintered samples prepared by the sonochemical method to evaluate the magnetic properties. An abrupt change in B-H loops was found with T_s for a maximum applied field of 1500 A/m. M-H loops with the maximum applied field of 1.6×10^3 KA/m and Mössbauer spectroscopy demonstrate that the samples are all at the ferrimagnetic stage. Curie temperatures T_c, determined from the temperature dependence of the initial permeability μ', for the same samples almost remained unchanged, which confirms that the cation distribution is almost unchanged with the variation of T_s. A slight variation of cation distribution manifested in the variation of T_c with T_s conforms with the site occupancy of Fe^{3+} analyzed by Mössbauer spectroscopy.

*Dept. of Materials Science, Atomic Energy Centre, Dhaka

2. Seminar/Symposium/Conference/Workshop Attended

Name of the person	Title of the event	Organizer	Date	Place
Dr. Engr. S. M, Hoque, Engr. F. M. Kamal, Dr. M. M. Haque, Dr. M. A. Mamun, M. R. Hasan, Dr. Engr. R. Rashid, Dr. M. N. I. Khan, S. I. Liba Dr. H. Das and A/ Kumar	National Conference on Electronics and Informatics	BES and BAEC	4-5 Dec. 2019	AECD
	International conference on Physics	Bangladesh Physical Society	5-7 Mar. 2020	AECD
Arijun Nahar	International conference on Physics	Bangladesh Physical Society	5-7 Mar. 2020	AECD

3. Training Courses and Seminars Organized

Speaker	Title of the event	Date	Place	No. of participent
Dr. Engr. S. M. Hoque	$Fe_xCo_{1-x}Fe_2O_4$ nanoparticles used as MRI contrast agent and cancer drug delivery	19 Sept. 2019	MSD	12
	An Expedition for the Grant Application,2020-2022	29 Sept. 2019	MSD	12
	A visit for the Grand Application, 2020-2022	07 Oct. 2019		10

4. Colaboration Work

- Collaboration with International Program for Physical Sciences (IPPS) under International Science Program of Uppsala University, Sweden on Magnetic and structural properties of Ferrites, Nanocomposites and Perovskite Materials
- Collaboration with different public and private Universities to do research work.

5. Service Rendered

5.1 Using XRD Machine

Name of the month	Name of institutions/organizations	Name of samples	No. of samples
Jul. 2019	SK+F Pharmaceticals, Ltd.	Doectaxel	01
	Dept. of AIUB, Dhaka	Lead	02
Oct. 2019	Dept. of KUET	TiO_2	01
Nov. 2019	Dept. of Chemistry, RU	Nano particles	02
	Dept. of Physics, DU	chitosan	03
	Dept. of Chemistry, RU	SiO_2	03
	BNACWC, Armed Forces Division, PM Office, Dhaka Cantonment	Ag NO_3	01
	Dept. Physics of RU	MR	01
	Dept. of Chemistry, RU	SiO_2	03
Dec. 2019	BCSIR, Rajshahi branch	Silver nano particles	06
	Dept. of Physics, BUET	Ferrite	04
	Dept. of Physics, BUET	Ferrite	02
	Dept. Chemistry of RU	SiO_2	01
Jan. 2020	Dept. of Chemistry, SUST	SiO_2	01
Feb. 2020	Dept. of BSCL	Jute Fiber	01
	Dept. of Physics, BUET	Ferrite	02
	Dept. of Biochemistry & Molecular Biology, RU	Ferrite	01
	Dept. of RU	Al_2O_3	02
	Dept. of Physics, BUET	Ferrite	01
Mar. 2020	Dept. of Physics, CU	Ceramics	04
Apr. 2020	Eskayef Pharmaceuticals Ltd.	Powder	01
Jun. 2020	Eskayef Pharmaceuticals Ltd.	REMDESIVIR	03
Total			42

5.2 Using SEM & EDAX Machine

Name of the month	Name of organizations	Name of samples	No. of samples
Jul. 2019	Dept. of Applied Chemistry & Chemical Engineering, DU	Na Alginate & Na Alginate -Go Composite	02
	Dept. of MEEE, AIUB	Green Cured Plate-Deep Cycle Lead Acid Battery	02
Aug. 2019	Dept. of Applied Chemistry and Chemical Engineering, RU	Cottonfabrics with copolymen	05
	Dept. of Physics, JU	ZnO Thin Film	01

Name of the month	Name of organizations	Name of samples	No. of samples
Sept. 2019	University of Asia Pacific	Bromhexine Hcl	03
	University of Asia Pacific	CHEIM-4	01
	University of Asia Pacific	CHEIM-2	01
Oct. 2019	Dept. of CEE, IUT	Micro Plastic	07
Nov. 2019	Dept. of Physics, DU	Chitosan Film	03
Dec. 2019	Dept. of Chemistry, SUST	SiO_2 Nano Particles	01
Total			26

5.3 Using Raman Spectroscopy System

Name of the month	Name of institutions/organizations	Name of samples	No. of samples
Nov. 2019	North South University	Para film	03
	BNACWC, Aramed Forces Division, PM Office, Dhaka Cantonment	Ag Nano Particles	01
Total			04

5.4 Using Zeta Potential

Name of the month	Name of institutions/organizations	Name of samples	No. of samples
Jul. 2019	University of Asia Pacific, Dhaka	SPEIM-4, PEIM-4, CHIM-4	03
	University of Asia Pacific, Dhaka	LEIM-4, PEIM-4, CHIM-4	03
Jan. 2020	Latif Bayon Jute Mill	Cellulose	09
Total			15

5.5 Using TEM/FESEM Machine

Name of the month	Name of organizations	Name of samples	No. of samples
Oct. 2019	Dept. of Physics, CUET	NiCuCd Ferrite	03
Nov. 2019	Dept. of EEE, IU, Kustia	Ag Nano Particle	06
	Dept. of Physics, RU	Gd Nano Particle	01
	Dept. of Physics, KUET	Nano Particles	02
	BNACWC, Armed Forces Division, PM Office and Dhaka Cantonment	Ag Nano Particles	01
	Dept. of Chemistry, JNU	ZHM geolite	01
Jan. 2020	Dept. of Pharmaceutical Science, NSU	Nano Particles	02
	Dept. of Physics, JU	Magnetic Nano Particles	06
	Dept. of Chemistry, BUET	Ni Cu Nano Particles	01
	Dept. of Chemistry, BUET	Ag And Au Nano Particles	02
	BCSIR	Nano Particles	02
	Dept. of Chemistry, BUET	Cu Nano Particles	01
	Dept. of Chemistry, JNU	ZnO Nano Particles	02
	Dept. of Mathematics and Physics, NSU	NiCuCd Ferrite NPs	01
Mar. 2020	Dept. of GCE, BUET	BFO, CBFONPS	02
	INST, AERE	Fiber	03
	Dept. of MME, BUET	Thin Film	07
Total			37

5.6 Using PPMS System

Name of the month	Name of institutions/organizations	Name of samples	No. of samples
Sept. 2019	Dept. of Chemistry, RU	Magnetic and magnetic Composites Particles	05
Nov. 2019	Dept. of Physics, BUET	Ni-Co-Zn	04
Dec. 2019	Dept. of Physics, BUET	LaCaSrMnO, SmCaSrMnO and PrCaSrMnO	20
	Dept. of Physics, BUET	Nd_2FeCrO_6 and Gd_2FeCrO_6	02
	Dept. of Glass and Ceramic Engineering, BUET	Bismmmuth Ferrite	04
	Dept. of Glass and Ceramic Engineering, BUET	Titenium Oxide	03
	Comilla University	Mg Ferrite	05
Jan. 2020	Dept. of Glass and Ceramic Engineering, BUET	Titenium Oxide	02
Feb. 2020	Dept. of Physics, BUET	Nd_2FeCrO_6 & Gd_2FeCrO_6	02
Mar. 2020	Dept. of IGCRT, BCSIR	Ferrite	09
	Dept. of MME, BUET	Bismuth Ferrite	04
Total			45

5.7 Using DSC

Name of the month	Name of institutions/organizations	Name of samples	No. of samples
Nov. 2019	M Pharma NSU	Para Film	03
Dec. 2019	Bangladesh Jute Research Institute	Kent PP	01
Mar. 2020	Bangladesh Jute Research Institute	HDPE & PLA Pellets	02
	NSU	Aceclofenoc solid dispersion	05
Total			11

5.8 Using FTIR Syatem

Name of the month	Name of organizations	Name of samples	No. of samples
Sept. 2019	Dept. of Physics, CUET	$NiCuCdLaFe_2O_4$, $NiMgCuCdFe_2O_4$, $NiMnCuCdFe_2O_4$	16
	Dept. of Physics, IU	Datim, Neem	04
Oct. 2019	Dept. of CEE, IUT	Microplastic	10
	Dept. of Applied Chemistry and Chemical Engineering, IU	Microplastic	11
Nov. 2019	M Pharma, NSU	Para Film	03
	NSU	Para film	02

Name of the month	Name of organizations	Name of samples	No. of samples
	BNACWC, Aramed Forces Division, PM Office Dhaka Cantonment	Ag Nano Particles	01
Feb. 2020	Dept. of Physics, BUET	Ferrite	01
Mar. 2020	NSU	Chitchon	10
Total			47

5.9 Using ASS System

Name of the month	Name of organizations	Name of samples	No. of samples
Apr. 2019	Dept. of Chamistry, SUST	Liquid	03
Total			03

5.10 Using DLS System

Name of the month	Name of organizations	Name of samples	No. of samples
Sept. 2019	Dept. of EEE, IU	Silver nano particles	06
Total			06

Medical Physics Division, AECD

Objective/Introduction

Medical Physics Division was established in 2014. The prime objective of this division is to provide academic lead in research, training as well as service in the field of medical physics. Medical Physics Division in Atomic Energy Centre, Dhaka is working with the close cooperation of "Institute of Nuclear Medical Physics (INMP)" at AERE, Savar, Dhaka. The prime objectives are:

- To develop qualified medical physics professionals with instrumental and clinical knowledge
- To provide medical physics expert services in hospitals over the country to manage cancer patients.

Program

- 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 Dosimetric characteristics of 6 MV medical Linac

R. Khatun, S. Akter and S. K. Roy*

Dosimetric characteristic is one of the most essential parameters of a linear accelerator (LINAC) which must be obtained prior to clinical use. The dosimetric characteristics for 6MV photon beam at Institute of Nuclear Medical Physics (INMP), Savar, Dhaka were measured and compared with the corresponding published data. The study was done using a Varian linear accelerator (Model Clinac-iX) at the Institute of Nuclear Medical Physics (INMP), AERE. The data is taken for 12 field sizes (3 × 3, 4 × 4, 6 × 6, 8 × 8, 10 × 10, 12 × 12, 15 × 15, 20 × 20, 25 × 25, 30 × 30, 35 × 35 and 40 × 40 cm2) at same conditions. For this study 3D water phantom, ionization chambers and electrometer are used. The measured PDD curves were obtained for 6MV photon beams with above mentioned field sizes and compared with different field size PDD curves calculated. The measured depth dose (Dmax) for reference field size (FS) 10×10 cm2 are15.99 mm and the PDD at 10 cm depth (D10) are 66.87% for 6 MV photon energies that are found to be compatible with the published report "BJR supplement 25". The measured PDD curves for photon energies show a good agreement with the standard PDD curves. In this study, the physical properties characterizing high energy photon beams of

(6MV) that include the central axis percentage depth dose (CADD), beam profile specification, tissue maximum ratio (TMR), surface dose and buildup region. Output factor, for different field sizes at different depths, were determined to show the effect of field size and beam energy on the central axis percentage depth dose also to show the effect of field size and depth on beam flatness, beam symmetry, penumbra and TMR.

*Pabna University of Science and Technology (PUST)

1.2 Thyroid uptake of Tc-99m and its agreement with I-131 for evaluation of hyperthyroid function

R. Khatun, S. Akter and M. Ohiduzzaman

Tc-99m has been used worldwide to study the thyroid function because of a number of advantages such as short half-life, short biological half-life, short effective half-life, short retention in gland and no Beta (β-) radiation, providing low dose to gland (10,000 times less than that of I-131), low cost and readily availability. Otherwise, I-131 with its high radiation burden (1-3 rad/mCi) has long half-life and causes Beta (β-) particle emission. Its main gamma photon has high energy (364 keV) which also causes poor image quality. The experiment is carried out at the Institute of Nuclear Medicine and Allied Sciences (INMAS), Bangladesh Atomic Energy Commission, Dhaka Medical College Hospital Campus, Dhaka-1000. In the present work, the study consists of 109 patients (76 female and 33 male) with ages ranging from 14 to 66 years. The patients studied with Tc-99m found to be hyperthyroid of 57 and in case of I-131, the findings were 60. The agreement between I-131 and Tc-99m is 95% and the correlation coefficient, r between Tc-99m & I- 31 is = 0.879, which indicates strong correlation between them. So, it is statistically significant and makes a good agreement.

*Jashore University of Science and Technology

1.3 Assessment of elemental concentration of milk powder collected from local market using PIXE technique

S. Akter, R. Khatun and S. Roy*

Foodstuff pollution is a major concern now-a-days, especially in Bangladesh. Toxicity assessment of baby food is essential before providing to the children. The quantitative estimation of trace and major elements, their concentration of ten different milk powder samples collected from local market has been done. The total experimental works from sample preparation to spectrum data analysis have been done at the Accelerator Laboratory of Atomic Energy Center, Dhaka. The IBA technique PIXE and spectrum analysis shows that the major elements found in all the ten samples are S, Cl, K, Ca, Fe, Cu, Zn, Se etc. The concentration of Potassium (1123.15±395.65 ppm) and Calcium (866.05±305.95 ppm) are seen relatively high in analyzed samples. The projection of Iron is 45.9±32.9 ppm. The elements and their concentration study of imported milk powder may provide a clear view whether any type of elemental or heavy metal toxicity is present or not. Further study will provide sufficient knowledge to evaluate the significance of the importance especially related to human health.

*Noakhali Science &Technology University

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

Name of the participant	Title of the event	Organizer	Date	Place
Dr. R. Khatun and S. Akter	International conference on Physics in Medicine	BAEC, BMPA & BMPT, DU	6-7 Feb. 2020	DU & AECD
	International conference on Physics	Bangladesh Physical Society	5-7 Mar.20 20	AECD

3. Collaboration Work/MoU

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.

4. Others

- Lecture delivered on FTC training course on "Nuclear and Radiological Emergency Preparedness Course at BAEC (NREPCB-7)-2019
- Training cum Seminar on "Procurement in e-GP System", 12 Nov. 2019, INMP, AERE, Savar.

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.

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 and A. Rahim

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

Depending on the geometry, dimension, orientation of the components, service condition, anticipated defect nature in the component and applicable codes & standards, the working procedures were developed for the inspection of different equipment used in various industrial sectors viz. Fertilizer Factory, Steel Structure, BITAC, BUET 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 and A. Rahim

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 and A. Rahim

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

Few experiments have been performed with the MultiScan MS 5800 Multi Frequency Eddy Current equipment having options to use 4 frequencies simultaneously. For this investigation, Stainless Steel tube having artificial defects of different volumes were analyzed experimentally.

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 and A. Rahim

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 & sp 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.

2. Manpower Development and Training Program

Title of the event	Date	Place	No. of participant
83rd National Training Course on Foundation Course on NDT	08 - 25 Jul. 2019	NDT Division	19
84th National Training Course on Radiographic Testing Level - 2	27 Oct. - 05 Dec. 2019	NDT Division	17
85th National Training Course on Radiographic Testing Level - 1	08 - 15 Mar. 2020	NDT Division	14

3. Arrangement of Seminar

Title of the event	Date	Place	No. of participant
Organized Seminar on Phased Array Ultrasonic Testing (PAUT)	19 Nov. 2019	AECD	32

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

Name of the Person	Title of the event	Organizer	Date	Place
Md. F. H. Chowdhury, S. C. Dey and A. Rahim	Seminar on Phased Array Ultrasonic Testing (PAUT), organized by NDT Division and Saj Engineering & Trading Company	NDT & SAJ	19 Nov. 2019	AECD
K. Alam, M. A. M. Islam and R. Pritom	Follow-up Training Course (FTC) on Nuclear and Radiological Emergency Preparedness	BAEC	24 Nov. - 05 Dec. 2019	BAEC

5. Collaboration Work(s)

5.1 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 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)".

5.2 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 63rd & 64th Flight Safety Officer's (FSO) Training Courses organized by the "Flight Safety Institute", Dhaka of Bangladesh Air Force (BAF). Besides the participants from Bangladesh Air Force, Bangladesh Army & Bangladesh Navy 2 participants from Royal Saudi, 2 participants from Srilanka & 1 participant from Royal Malaysian Air force were present in these courses. The NDT Division also conducted day long practical demonstration class for the above courses. This collaboration is likely to be continued.

5.3 Practical demonstration for University students

Within this reporting period, NDT Division of BAEC arranged Practical demonstration on different NDT methods to the course "Non Destructive Testing and Machine Condition Monitoring Sessional" (Course Code: NSE410) for 39 students of Level - 4/Term - 1 of Dept. of Nuclear Science and Engineering, Military Institute of Science and Technology (MIST) to provide application based knowledge on NDT methods as a part of their curriculum activities which was postponed after conducting 1st sessional class because of general holiday announced by Government of the Peoples' Republic of Bangladesh due to COVID-19 pandemic.

5.4 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 three weeks long Internship Program on Industrial Training as a part of the curriculum activities for 2 B.Sc. students

of 3rd year, Dept. of Nuclear Engineering, University of Dhaka from 17 Dec. 2019 - 06 Jan. 2020 to provide familiarization and application based knowledge on NDT methods.

5.5 Inspection of the Manufacturing of LTME for the construction of Rooppur Nuclear Power Plant

Name of person	Duration	Place
M. F. H. Chowdhury	10 Jul. - 10 Oct. 2019	Volgadon, Russia
M. S. Alam	08 Apr. - 31 Jul. 2019 & 29 Oct. 2019 - 20 Jan. 2020	Volgadon, Russia
M. N. N. Alam	18 Nov. 2019 - 17 Feb. 2020	Saint Petersburg, Russia
M. A. Habib	21 Aug. - 14 Nov. 2019 & 20 Feb. - till now	Saint Petersburg, Russia
S. C. Dey	25 Nov. 2019 - 24 Feb. 2020	Petrozavodsk, Russia

6. Service Rendered and Revenue Income

Name of service given to the organization	Nature of service	No. of service	Income
Bay-Tech NDT & Engineering Services, Bangladesh Industrial Testing & Services Ltd., SAFE Naval Architects & Marine, Consultants, Innovative Engineering Services, IES- Industrial Engineering Services, Western Marine Services Ltd., Naval & Marine Consultants, Faruque Dockyard & Engineering Works and Fleuve Naval Architects	Calibration of Ultrasonic Thickness Gauge	10	20000/-
4 times to IPCO Developments (Bangladesh) Ltd. & IPCO Hotels Ltd.	Ultrasonic Testing of Welding joints of Beams of Banquet Hall of IPCO Developments (BD) Ltd. at Airport Kurmitola Project	456	154275/-
3 times to BITAC, Dhaka	Ultrasonic Testing of Journal Bearing	3	10000/-
Jamuna Fertilizer Co. Ltd.	Magnetic Particle Testing of Tube Welding Joints of Steam Drum of Package Boiler-C of JFCL at Tarakandi, Jamalpur	1225	-
3 times to ARK Engineering	Radiographic Testing of welding joints of mild steel pipes manufactured for Welder Qualification Test of ARK Engineering	15	9400/-
Solution NDT & Inspection Services	Calibration of Ultrasonic Flaw Detector, Calibration of Ultrasonic Thickness Gauge and Calibration of Electromagnetic Hand Yoke	3	7000/-
Bangladesh Industrial X-ray	Calibration of Ultrasonic Flaw Detector	1	3000/-
BUET	Digital Radiographic Testing of Metal Samples	2	2000/-
Q & T Industrial Inspection Co.	Calibration of Ultrasonic Flaw Detector, Thickness Gauge, Electromagnetic Hand Yoke and UV Light Meter	6	13000/-
Sylhet Gas Fields Ltd.	Consulting Service to 3000 BPD CRU Project at Rashidpur, Bahubal, Habiganj	15 man day	-
Saj Engineering & Trading Co.	Calibration of Electromagnetic Hand Yoke	1	2000/-
Total			220675/-

Accelerator Facilities Division, AECD

Objective/Introduction

The objectives of this Division are (a) to operate and maintain the 3 MV Van de Graaff Accelerator and its associated sub-systems (b) to enrich the Ion Beam experimental facilities (c) to utilize the Ion Beam for research and development works in the field of health, environment, agriculture and industry. (d) to operate the 'Gamma Spectroscopy System', detection & analysis of radionuclides in different samples.

Activities

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 elemental analysis of Environ., health, biological, agricultural and industrial specimens. This division has also been developed a 'Gamma Spectrometry System' using existing HPGe detector, Lead shielded chamber, spectroscopy amplifier, MCA and associated other electronic circuitries. The system is being used for the detection and analysis of radiological substances, their activities in various specimens of the earth surface and the products are as follows.

1. Research and Development Work(s)

1.1 Operation and management of the 3 MV VDG accelerator and gamma spectrometry system

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

Objective: Radionuclides detection & analysis the data spectrum using 'Gamma Spectrometry'

Current progress: The VDG Accelerator is operational. According to the user's demand, the accelerator is to operate, produce and accelerate the proton beam for irradiation of different specimens. For quantitative measurements of both the essential and toxic elements of foodstuff like vegetables, fruits and milk samples. Specimens collected from Cox's Bazar Sea Beach area, medicinal plants, soil and vegetables have been dried, ground & prepared as pellets and irradiated the pellets by proton beam of 10 to 15nA.

Detection & analysis of radiological substances in different samples collected from coalmine & waterfall areas, milk & vegetable samples from local market using 'Gamma Spectrometry' System of Accelerator Laboratory of AECD. The students of different universities have been done their thesis experiments for MS, MPhil and PhD degrees using 'Gamma Spectrometry' technique with the collaboration of VDG Accelerator laboratory.

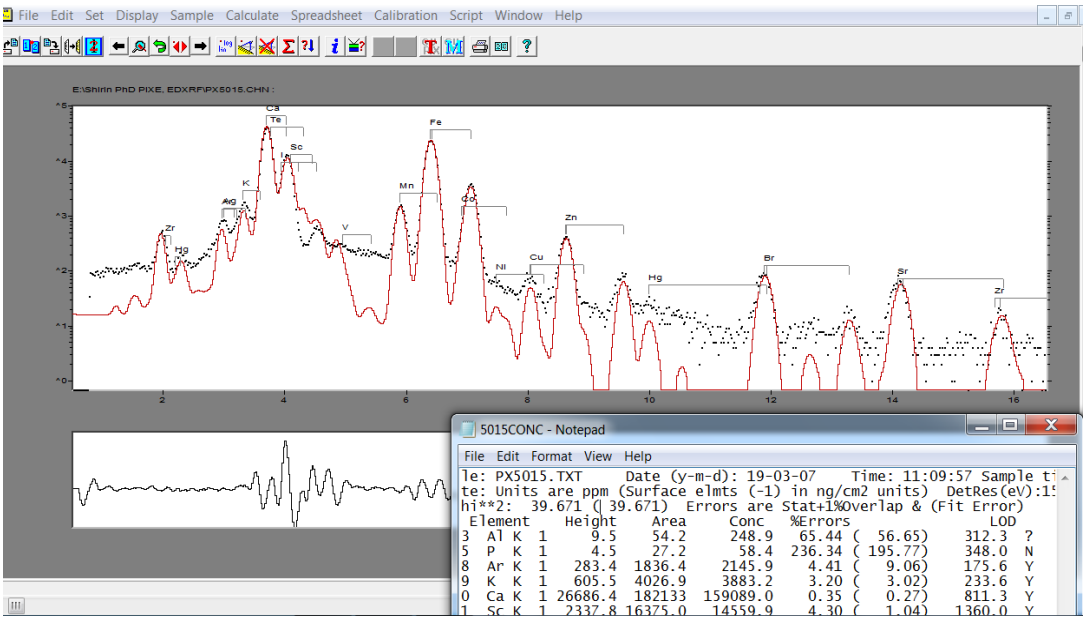
1.2 Assessment of essential and toxic elements in different foodstuff by PIXE technique, radionuclide detection and possible health risk assessment

J. Abedin, M. Rahman and S. Akter

Objective: To analyze the elemental concentration, detection of radiological substances contained in imported and locally produced foodstuffs and their health risks assessment

Current progress: A number of different milk powder, fruit and vegetable samples have been collected from local market, dried, ground and made as pellets (7mm diameter & 1mm thick). The pellets have been irradiated by 2.4 MeV proton beam and with the beam current of 10 to 15 nA. The data acquisition were done by PIXE technique and using MAESTRO-32 software VDG Accelerator Lab. The data file has been analyzed for elemental assessment.

A analyzed PIXE spectrum data of one of the vegetable sample is projected below:



Major portion of each samples have been taken under gamma experiments for radiological assessment of that sample & as well as the area from where the specimens have been collected.

Analyzed data (gamma experiment), Sample Title: Radionuclide detection of Four 'Shad', Peak Analysis Performed on: 12/9/2019 3:06:32 PM

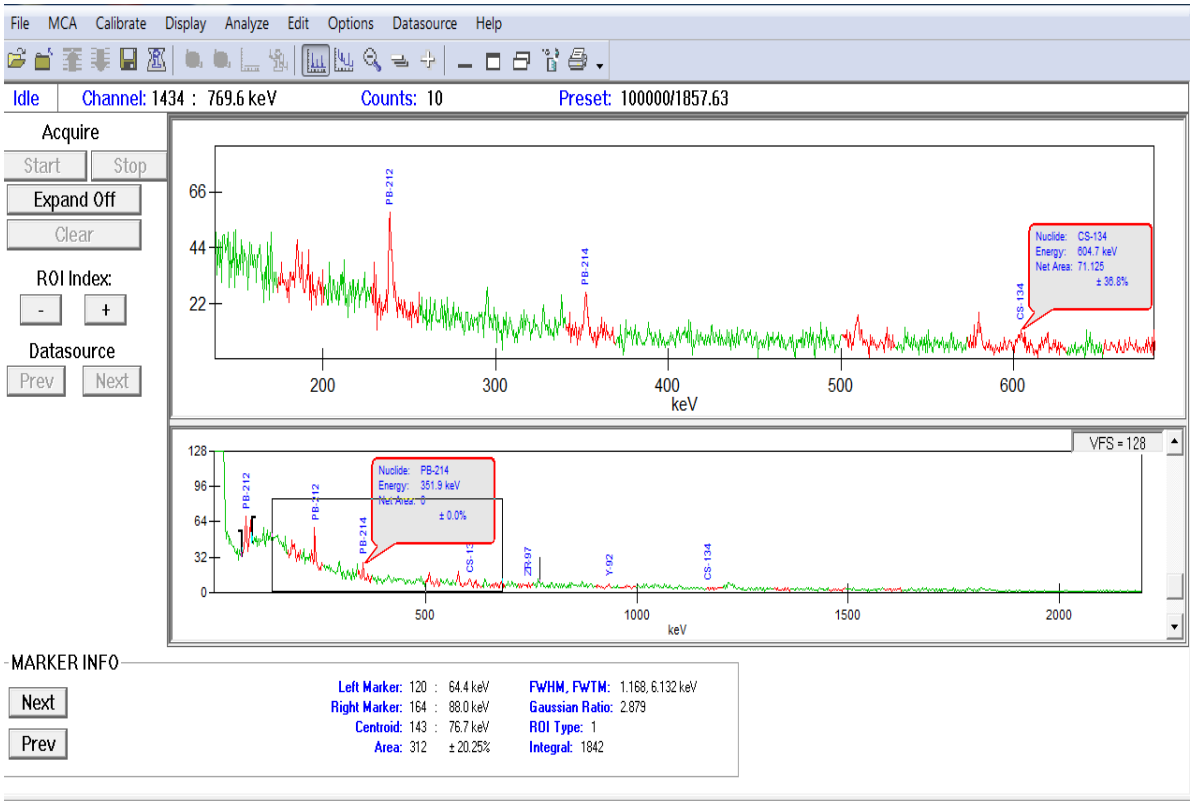
Peak No.	ROI start	ROI end	Peak centroid	Energy (keV)	FWHM (keV)	Net Peak Area	Net Area Uncert.	Continuum Counts
1	129-	168	139.19	74.16	2.63	4.569E+02	39.87	1.495E+03
2	129-	168	158.91	84.66	2.69	2.909E+02	36.42	1.583E+03
3	333-	356	343.38	182.94	0.61	5.700E+01	92.55	2.126E+03
4	437-	467	447.46	238.39	1.12	2.029E+02	92.20	1.701E+03
5	650-	672	660.71	352.01	1.19	2.880E+01	53.81	7.372E+02
6	949-	971	960.01	511.46	1.81	1.038E+02	40.56	3.952E+02
7	1084-	1156	1095.36	583.57	1.91	4.335E+01	52.19	1.632E+02
8	1084-	1156	1144.50	609.75	1.97	3.780E+01	45.50	1.574E+02
9	1604-	1627	1615.64	860.77	1.13	5.347E+00	26.02	1.677E+02
10	1699-	1724	1711.75	911.97	2.06	1.554E+02	27.14	1.366E+02
11	1807-	1832	1819.80	969.53	2.18	5.809E+01	27.66	1.659E+02
12	1963-	1988	1975.16	1052.31	2.21	5.297E+01	22.44	1.060E+02
13	2092-	2117	2104.12	1121.01	1.98	5.278E+01	23.51	1.152E+02
14	2313-	2338	2325.52	1238.97	0.93	1.950E+01	24.53	1.365E+02
15	2730-	2758	2743.45	1461.63	2.47	3.718E+02	24.80	5.319E+01
16	2974-	3001	2987.17	1591.47	3.04	5.056E+01	15.63	4.244E+01
17	3277-	3306	3291.01	1753.35	1.01	6.350E+01	13.08	2.250E+01

1.3 Elemental analysis and pollution assessment of soil samples of Chittagong and Cox's Bazar sea beach area

J. Abedin, M. Rahman and L. Jaman

Objective: To detect & analysis the radiological substances accumulated in Cox's Bazar Sea Beach area of Bangladesh using 'Gamma Spectroscopy' technique. The goal of the research works is to determine the radiological substances available in 'Sea Beach Soil' and to assess by getting sufficient information for the evaluation of their impacts on the environment as well as on living beings.

Current progress: Samples were collected from Cox's Bazar Sea Beach area. Each sample was about 500gm and was taken under gamma experiments using 'Gamma Spectrometry' data acquisition setup. 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 data analysis were done according to the energy lines of different radionuclides by Genie-2000 software. The detected energy lines of different radionuclides of one of the soil samples is shown here:

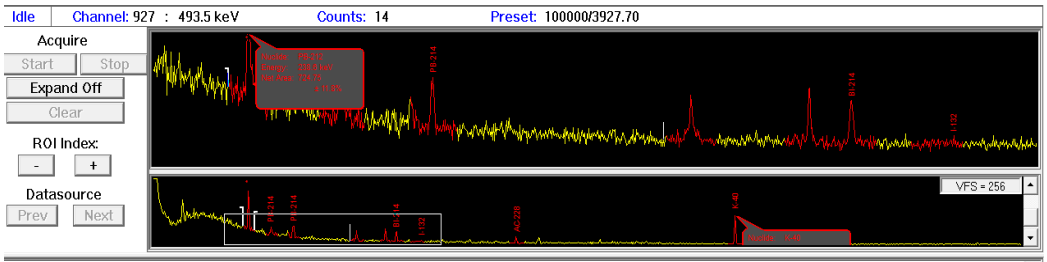


1.4 Assessment of radionuclides accumulated in fishes and sediments of polluted lakes in Dhaka city using 'gamma spectrometry' technique at VDG accelerator laboratory of AECD

J. Abedin, M. Rahman and L. Hossain

Objective: To detect & analyze of radiological substances accumulated in fishes & sediments of polluted lakes of Dhaka city and their impacts

Current progress: Fish and sediment samples (300gm of each) were collected from a number of locations of Gulshan lake, taken under gamma experiments using 'Gamma Spectrometry' data acquisition setup. Spectrum data has been collected and analyzed by software 'Genie-2000'. Analyzed spectrum data from one of the sediment samples is projected below:



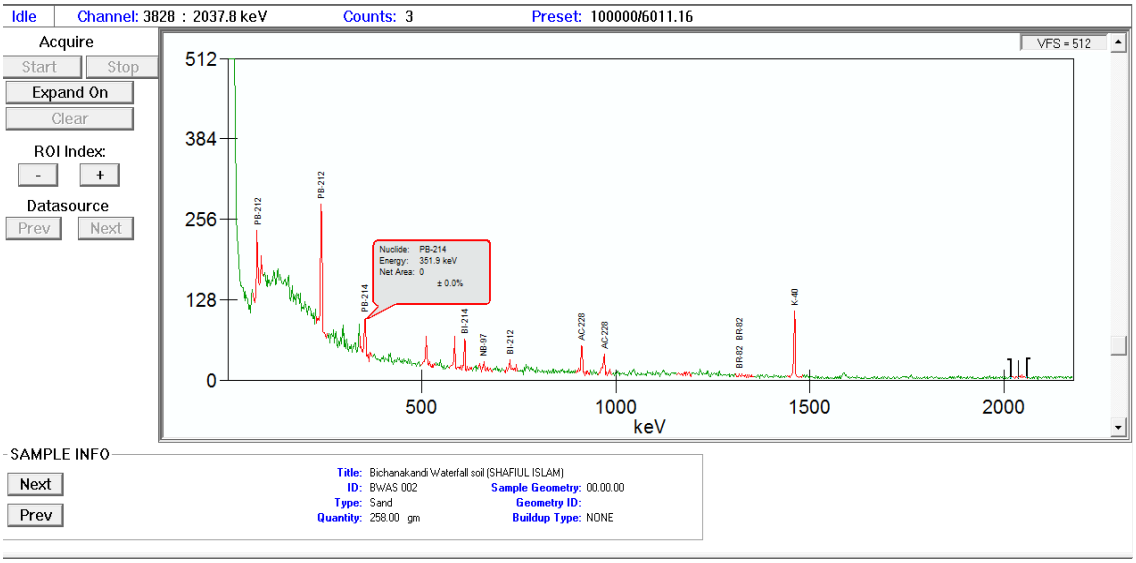
	Peak No.	ROI start	ROI end	Peak centroid	Energy (keV)	FWHM (keV)	Net Peak Area	Net Area Uncert.	Continuum Counts
M	1	127-	170	139.23	74.12	3.13	4.126E+02	42.83	1.761E+03
m	2	127-	170	159.87	85.11	3.20	9.845E+01	34.72	1.900E+03
	3	439-	463	448.03	238.50	1.71	6.781E+02	78.93	1.335E+03
	4	544-	567	555.47	295.70	1.44	2.427E+02	57.00	7.513E+02
M	5	625-	671	635.16	338.12	1.95	1.147E+02	18.00	3.125E+02
m	6	625-	671	660.23	351.47	1.99	1.821E+02	20.23	3.204E+02
	7	945-	972	959.36	510.71	1.27	1.802E+02	44.10	3.918E+02
M	8	1084-	1156	1095.79	583.33	1.93	1.646E+02	18.27	1.665E+02

1.5 Assessment of Environ. toxicity of some waterfall areas of Bangladesh by PIXE technique and radionuclide detection using gamma spectrometry

J. Abedin, M. Rahman and M. S. Islam

Objective: Study the Environ. toxicity of waterfall areas of Bangladesh due to heavy metal and radionuclides accumulation and to assess its radiological effects on human health

Current progress: Samples have been collected from different waterfall areas of Sylhet and Chittagong and preserved for nuclide detection using 'Gamma Spectroscopy' system of VDG accelerator laboratory of AECD. The major portion (500gm) of each of the samples has been taken under gamma experiments; spectrum data collected and analyzed using Genie-2000 software. The analyzed gamma data from one of soil samples is shown:

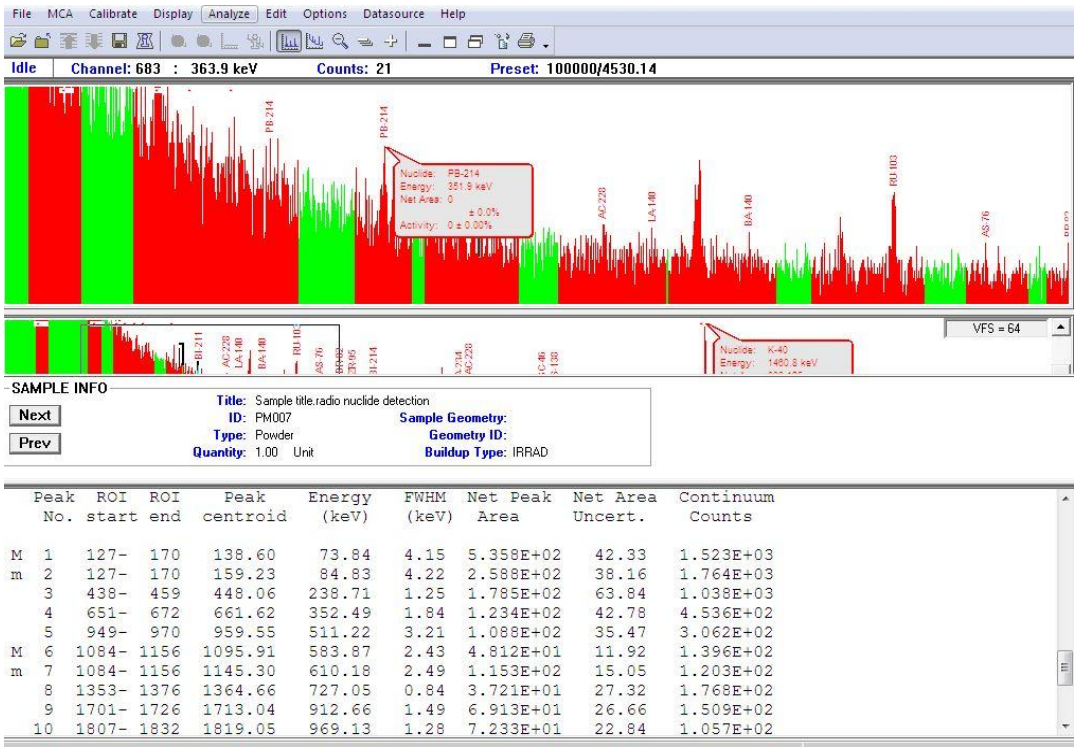


1.6 Assessment of radioactivity of baby food collected from local market using 'gamma spectrometry' technique

J. Abedin, M. Rahman and S. Roy

Objective: Analyze the radiological substances contain in baby foods available in the local markets and their impacts

Current progress: Different types (brands) of baby food were collected from local market, taken under gamma experiments, collected gamma spectrums and analyzed the data files using commercial software Genie-2000. One of the analyzed spectrum data has been projected below:



	Peak No.	ROI start	ROI end	Peak centroid	Energy (keV)	FWHM (keV)	Net Peak Area	Net Area Uncert.	Continuum Counts
M	1	127-	170	138.60	73.84	4.15	5.358E+02	42.33	1.523E+03
m	2	127-	170	159.23	84.83	4.22	2.588E+02	38.16	1.764E+03
	3	438-	459	448.06	238.71	1.25	1.785E+02	63.84	1.038E+03
	4	651-	672	661.62	352.49	1.84	1.234E+02	42.78	4.536E+02
	5	949-	970	959.55	511.22	3.21	1.088E+02	35.47	3.062E+02
M	6	1084-	1156	1095.91	583.87	2.43	4.812E+01	11.92	1.396E+02
m	7	1084-	1156	1145.30	610.18	2.49	1.153E+02	15.05	1.203E+02
	8	1353-	1376	1364.66	727.05	0.84	3.721E+01	27.32	1.768E+02
	9	1701-	1726	1713.04	912.66	1.49	6.913E+01	26.66	1.509E+02
	10	1807-	1832	1819.05	969.13	1.28	7.233E+01	22.84	1.057E+02

MS thesis prepared, submitted under this program to the Dept. of Computer Science and Telecommunication Engineering, Noakhali Science and Technology University and degree has been awarded.

Plasma Physics Division, AECD

Objective/Introduction

The plasma physics division is the newest division of the Atomic Energy Center, Dhaka (AECD) which is started to work in Jan. 2016 to promote fundamental, advanced and applied research works in the related areas of plasma physics. The major objective of the plasma physics division is to build up capacity in the area of plasma research and plasma based technology development. The major areas of research and development are as follows: Theoretical, computational and experimental studies on the Space plasma, Astrophysical plasma, Industrial plasma and Fusion plasma, etc.

Activities

1. Research and Development Work(s)

1.1 Optimization of a dense plasma focus (DPF) device and design and development of an efficient DPF device for the home organization

L. Akter, M. A. Malek, M. R. Haque and M. K. Islam

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. The plasma focus device is composed with two sections: The first section is pre-pinch (axial) section and the second one is the radial pinch phase section. We have studied the fusion neutron and soft X-ray production from a low energy DPF as a function of pressure and the dimension of electrodes.

Study on the Fusion Neutron Production: From the numerical experiment, a basic understanding has been acquired about the working principle and neutron production of a miniature device with different filling gas pressure. Correlation of neutron yield 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.

Study on the Neon Soft X-ray Production: The UNU/ICTP PFF is a 3kJ DPF machine which is operated at 14 kV, 30 μF. In our present research work, the neon soft X-ray yield is improved from optimized UNU/ICTP PFF device by computing the optimum combination of inductance with anode length, anode radius and cathode radius, keeping their ratio constant at 3.368 through a lot of numerical experiments at four operating pressures. 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 PFF machine.

1.2 Study on the photoelectric effect on the instability of dust modes in a collisional, streaming and magnetized/unmagnetized dusty plasma with dust charge fluctuation

M. S. Munir, A. Hossain, N. A. Chowdhury and M. K. Islam,

Objective: This study will help the researcher to understand the effect of photoelectron on the Dust Ion Acoustic (DIA) and Dust Lower Hybrid Mode (DLH) modes in dusty plasmas in both laboratory and space, such as the planetary rings, the lower ionosphere/magnetosphere of the Earth, interstellar space cloud, etc.

Current progress: The conditions of instability of electrostatic dust modes in magnetized/unmagnetized dusty plasmas with negatively charged dust grains, streaming and collisional effect are investigated theoretically. We find that the ultra-low frequency DLH mode can be unstable due to photoelectric effect when the streaming velocity of electron is sufficiently low. In the case of DIA mode, we also found that the photoelectric effect has significant effect on the mode and the growth rate of the instability of the DIA mode increases with the increase of photon energy.

1.3 Theoretical Studies on Fusion Plasma

N. A. Chowdhury

Objective: Energy is essential for heating, lighting homes, producing food, operating industrial facilities, enabling communication, providing public and private transportations, etc. Standard living is directly proportional to energy consumption. But there is a clear discrepancy between the minimum requirement of energy and the production of the energy. Now, fusion plasma physics is one of the new fundamental branches of physics and is also used to generate the essential energy for living.

Current progress: Kinetic theory of plasma particles is rigorously important for understanding the real picture of the laboratory fusion plasma. Now, I have been working on the application of kinetic theory in fusion plasma under extreme conditions of temperature and density.

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

Name of the person	Title of the event	Organizer	Date	Place
Dr. M. K. Islam	Introduction to Fusion Technologies	Information Centre, Novo Theater, Dhaka	13 Apr. 2020	Novo Theater, Dhaka
	Capacity Building for Upcoming Fusion Reactor	AECD	31 Oct. 2019	AECD

3. Manpower Development and Training Program

Title of the event	Date	Place	No. of participant
Industrial Training (Dept. of Nuclear Engineering, University of Dhaka)	21-30 Dec. 2019	AECD	01

4. Collaboration Work

For capacity building of the Plasma Physics Division, the division is collaborating with the Plasma Research Centre, University of Tsukuba, Tsukuba, Japan.This division is also involved with the collaborative research work on the matters of common interest of the plasma physics group of different public and private Universities in the country. The division has close cooperation with teachers and research students (M.Sc., M.Phil. and Ph.D.) of various Universities concerning academic works.

5. Other(s) Scientific Popular Article

Published 4 scientific articles in Vital Science Magazine

ATOMIC ENERGY RESEARCH ESTABLISHMENT (AERE), SAVAR

CENTER FOR RESEARCH REACTOR (CRR), AERE

Objectives/Introduction

Bangladesh Atomic Energy Commission (BAEC) TRIGA research reactor is the only nuclear reactor in the country. It has a maximum steady state thermal power of 3 MW. The reactor achieved its first criticality on 14 Sept. 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. These reports are sent to the IAEA through Bangladesh Atomic Energy Regulatory Authority (BAERA) and International Affairs Division (IAD) of BAEC. CRR is now working on an ADP project entitled, "Balancing, Modernization, Refurbishment and Extension (BMRE) of Safety Systems of the 3 MW TRIGA Mark-II Research Reactor Facility at AERE, Savar, Dhaka". The main objectives of the project are to increase operating life of the reactor (about 15 to 20 years) by implementing ageing management of different system/components of the reactor.

Activities

1. Research and Development Work(s)

R & D Works: During the reporting period the reactor was operated at power levels of 50 W to 3000 kW for reactor physics experiments conducted by CRR personnel and to provide neutron beam for various reactor users. During this period, the total operating hour was about 53 and total burn up of the reactor fuel was about 33 MWh. A total number of 340 samples were irradiated through 37 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. In addition with that study of 41Ar activity release rate from the Bangladesh Atomic Energy Commission TRIGA Research Reactor has been performed.

2. Manpower Development and Training Program

Title of the event	Date	Place	No. of participants
Project Work [For the Students of B. Sc. (Honors) Physics, University of Science & Technology, Pabna]	21 Jun.-21 Sept. 2019	CRR	02
Inhouse Training on Emergency Preparedness and Response-IV	23 Jul. 2019	CRR	16
Inhouse Training on Different Type of Radiation	23 Jul. 2019	CRR	16
Inhouse Training on Periodic Maintenance System	23 Jul. 2019	CRR	16
Inhouse Training on Air Conditioning System of BTRR	25 Jul. 2019	CRR	17
Inhouse Training on Nuclear Fuel Cycle and Management	25 Jul. 2019	CRR	17
Emergency Evacuation Drill	22 Aug. 2019	CRR	17
Emergency Fire Drill	22 Aug. 2019	CRR	17
Inhouse Training on Periodic Safety Review of the Research Reactor	11 Sept. 2019	CRR	16
Inhouse Training on Management of the Response to a Nuclear Security Event at CRR	11 Sept. 2019	CRR	17
Inhouse Training on Digital Control Console Present Status	11 Sept. 2019	CRR	18
Inhouse Training on Reactor Cooling System	07 Oct. 2019	CRR	19
Inhouse Training on Experimental Facilities of BTRR	07 Oct. 2019	CRR	19

Title of the event	Date	Place	No. of participants
Presentation on Periodic Safety Review of BTRR-1	27 Oct. 2019	CRR	30
Industrial Training for the Students of 4th Year, 2nd semester, Dept. of Mechanical Engineering, DUET	16 Oct.- 04 Nov. 2019	CRR	29
Industrial Training for the Students of B.Sc. Engineering, Dept. of Electrical & Electronic Engineering, IUT	11 Nov. - 02 Dec. 2019	CRR	168
Inhouse Training on জাতীয় শুদ্ধাচার কৌশল এবং এ বিষয়ে সিআরআর এর কার্যক্রম	28 Nov. 2019	CRR	20
Inhouse Training on Reactor On-site Emergency Response Plan & Safety Instruction	28 Nov. 2019	CRR	20
Inhouse Training on Emergency Evacuation Drill for CRR Personnel	12 Dec. 2019	CRR	16
Inhouse Training on Emergency Fire Drill for CRR Personnel	12 Dec. 2019	CRR	16
Industrial Training for the Students of B.Sc. Engineering, 3rd Year, Level-3, Dept. of Nuclear Engineering, MIST	29 Dec. 2019 - 02 Jan. 2020	CRR	40
Industrial Training for the Students of B.Sc. 4th Batch, 3rd Year, Dept. of Nuclear Engineering, DU	09 Dec. - 31 Dec. 2019	CRR	03
Inhouse Training on Technical Specification of the Digital Control Console System	22 Jan. 2020	CRR	21
Inhouse Training on Control Rod Reactivity Measurement	27 Jan. 2020	CRR	22
Inhouse Training on Basics of Radiation and Radiation Protection	18 Feb. 2020	CRR	20
Inhouse Training on Environ. Radio Activity Monitoring	18 Feb. 2020	CRR	20
Practical Experiment for the participants of Follow-up Training Course (FTC) on Reactor Engineering-2020	18 Feb. 2020	CRR	16

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

Name of the person	Title of the event	Organizer	Date	Place
Dr. M. A. M. Soner	CIET	DU	23-24 Dec. 19	DU

4. Stakeholder Meeting

Title of the event	Organizer	Date	Place
Experience Sharing with Research Reactor Stakeholders for Proposed New Research Reactor Project	CRR	24 Oct. 2019	AERE
Reactor Fuel Burn-up and Core Reshuffle/Core Reloading.	CRR	16 Jan. 2020	AERE
Use of BTRR	CRR	16 Feb. 2020	AERE
Isotope Production by Using Reactor	CRR	17 Feb. 2020	AERE

5. Collaboration Work(s)

- TC Project (ongoing): Strengthening operational safety, design & development of spent fuel storage facility of the BAEC TRIGA research reactor and capacity building for the design of a thermal hydraulics and reactor safety testing laboratory
- 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
- ADP Project (ongoing): Technical Study Project to Establish High Power Research Reactor in Bangladesh.

6. Repair & Maintenance and Renovation Works

Jul. 2019	• Secondary Pipeline Strainer Cleaning: Secondary pipeline water was removed, strainer was cleaned and priming of the secondary pump was done carefully • Upgraded the digital console system two UPS batteries (for DAC and CCS) were replaced by new maintenance free sealed lead acid batteries (26AhX12 Nos) to extent the backup time • Refurbishment of Transient Control Rod Drive System was done by replacing old air compressor, regulator, pressure gauge and with the clean of air accumulator • One burned capacitor of PFI unit has been replacement carefully
Aug. 2019	• Maintenance of the cooling tower : Mechanical cleaning were undertaken as per schedule to remove the deposited soft sludge and scale from the basin and secondary pipe to minimize the fouling effect in secondary cooling system
Sept. 2019	• Repair and maintenance of Transient Control Rod Drive System: Replacement of the Air compressor, Air filter, Regulator, Pressure Gauge, Safety valve, pipe and fitting etc. • Quarterly Surveillance program was performed successfully • The exhaust blower motor of the reactor hall ventilation system was repaired by rewinding • Cassette type room air coolers (two # 5 ton and three # 2.5 ton) were installed in the reactor control room and public gallery at CRR under BMRE project
Oct. 2019	• Secondary pipe line Strainer cleaning & maintenance was done effectively • Maintenance of Service water line of reactor overhead tank was performed carefully • Cleaning and maintenance of MDB board, LT panel as well as 11kV/440V transformer were done carefully
Nov. 2019	• Repair and installation of TRIGA Fuel element inspection tool • Quarterly Surveillance program was performed efficiently • Four (4) magnetic contactors and One (1) timer of reactor hall ventilation system have been replaced by new ones
Dec. 2019	• Annual maintenance and surveillance activities were performed for the following mechanical systems: Primary pumps, Secondary pumps, 250 kVA & 650 kVA Generators, Water treatment plant, Fire pump, 10 HP pump, Ventilation system etc.
Jan. 2020	• Vibration monitoring: Primary and secondary pumps and motors vibration were measured to check the operating condition of the system
Feb. 2020	• Cleaning and maintenance work of Cooling Tower: The Cooling Tower Water was Removed & Cooling Tower Sump was cleaned, greasing of the cooling tower fan (CT-1 & CT-2) was done carefully along with priming of Secondary Pump & pipe line
Jun. 2020	• Semi-annual Maintenance and surveillance program were performed efficiently.

INSTITUTE OF NUCLEAR SCIENCE AND TECHNOLOGY (INST), AERE

Radioisotope Production Division, INST

Objective

The objective of Radioisotope Production Division (RIPD) is to substitute the import of medical radioisotopes, Tc-99m cold kit and therapeutic radiopharmaceuticals by indigenous production. To achieve the goal the production and supply of two medically important radioisotopes Tc-99m and I-131 are regularly done. RIPD is now meeting the entire demand of Mo-99/Tc-99m generator of 15 Nuclear medicine centers under the umbrella of Bangladesh Atomic Energy Commission and also supplies Mo-99/Tc-99m generators to some private and government run nuclear medicine centers. The Mo-99/Tc-99m generators produced at the cGMP compliant facility are comparable with the best quality generator available in the global market. RIPD also dispense Bulk I-131 which is extensively used in the 15 Nuclear medicine centers of BAEC. Beside this, RIPD also conducts research & development works in the field of medical radioisotopes and radiopharmaceuticals.

Activities

1. Research and Development Work(s)

- Test production of different cold kits like DTPA, DMSA and MDP
- Gamma Radiation Shielding Efficiency study for locally available beach sand minerals based composite materials
- Use of Chitosan as potential adsorbent material for $^{99}Mo/^{99m}Tc$ Generators
- Effect of Radioactive Concentration of $Na_2{}^{99}MoO_4$ on Chromatographic $^{99}Mo/^{99m}Tc$ Generator.

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

Name of the participant	Title of the event	Organizer	Date	Place
M. J. Uddin	Infrastructure Strengthening Project of Nuclear Medicine in Bangladesh for Treatment of Non-communicable Disease	KOICA	01 Mar. 2019-29 Feb. 2020	South Korea
M. M. Rahman	Instructor Training Course	JAEA	17 Jun. - 26 Jul. 2019	Japan
D. Chowdhury	2019 RCA/iTRS-HYU Radiation Safety Training Course	RCA	01-05 Jul. 2019	South Korea
Dr R. Akhter	FY2019 FNCA Workshop on Research Reactor Utilization Project	JAEA	10-12 Sept. 2019	Kazakhstan
S. M. M. Mouna	KOICA-IAEA Establishment of long-Term Management Plan by Strengthening Capacity for Diagnostic and Therapeutic Radioisotopes and Radiopharmaceuticals Application	KOICA	22 Sept.-05 Oct. 2019	South Korea
	Environ. Radioactivity Monitoring Course	BAEC and JAEA	12-16 Jan. 2020	AERE
Dr. M. F. Waheed	5th WNU School on Radiation Technologies	IAEA	14 -25 Oct. 2019	Russia
	The CN-276:International Symposium on Trends in Radiopharmaceuticals (ISTR-2019)	IAEA	28 Oct.-01 Nov. 2019	Austria
R. Amin	Nuclear and Radiological Emergency Preparedness Course	BAEC and JAEA	24 Nov.-05 Dec. 2019	AERE

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

Name of Speaker	Topic	Date	Venue
M. M. Rahman	An overview on Nuclear and Radiological Emergency Preparedness	06 Aug. 2019	INST, AERE
R. Amin	Syntheses, characterization and Antimicrobial Activities of Nickel(II) Comlexes of a Tetraazamacrocycle(L_c) and Its Cyanoethyl N-Pendent Derivative (L_{cx})	22 Jan. 2020	INST, AERE

4. Repair & Maintenance Work

- Operation & maintenance of the cGMP complaint computer controlled on-line Tc-99m generator production facility at RIPD and I-131 Production Plant
- Maintenance of non-pyrogenic water production plant, hot air sterilizer, steam sterilizer

- Operation and maintenance of evacuation chamber for vacuum vial preparation
- Operation & maintenance of HPGe
- Operation & maintenance of peristaltic pump.
- Operation & maintenance of Tc-99m Cold Kit production facility
- Repair & maintenance of centralized HVAC system.

5. Collaboration Work(s)

IAEA TC Project BGD/6/022: "Producing Therapeutic Radiopharmaceuticals"

Objective: To produce and supply of Therapeutic Radiopharmaceutical (Lu-177) to meet the local demand of these isotopes is under implementation. Three scientific visits and one fellowship had been completed.

6. Service Rendered and Revenue Income

No. of organization	Nature of service	Quantity	Income
22	Supply of ^{99}Mo/ ^{99m}Tc generator	497	46347745/-
16	Supply of I-131 radioisotope	2265 GBq	20760262/-
Total			67108007/-

7. Lecture Delivered

The scientist of this division conducted full theoretical and practical courses of Radiopharmacy for the M. Phill course of BSMMU in 2019 & 2020.

Nuclear and Radiation Chemistry Division, INST

Objective/ Introduction

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 Preparation and improvement of swelling behavior of PVA, PVP and acrylic acid blend hydrogel by gamma radiation

M. S. Rahaman, S. M. M. Hasnine, T. Ahmed and S. Sultana

Hydrogels from polyvinylpyrrolidone (PVP) and polyvinyl alcohol (PVA) networks impregnated with acrylic acid (AAc) was prepared by gamma radiation at 25 kGy from ^{60}Co gamma source. PVA and PVP were taken in the blend as a ratio of 40:60, 50:50 and 60:40 and AAc was introduced having concentrations varying within 0-3 wt.%. Effects of variations in PVA and/or AAc contents were observed on the properties such as gel fraction, swelling ratio. Higher amounts of both PVA-content and AAc-content increased the gel-fraction of the hydrogel blends and, consequently, decreased the swelling ratio.

1.2 Removal of methylene blue dye from aqueous solution by PVA, PVP and acrylic acid blend hydrogels prepared by gamma radiation

M. S. Rahaman, S. M. M. Hasnine, T. Ahmed and S. Sultana

Hydrogels from polyvinylpyrrolidone (PVP) and polyvinyl alcohol (PVA) networks impregnated with acrylic acid (AAc) was prepared by gamma radiation at 25 kGy from ^{60}Co gamma source. PVA and PVP were taken in the blend having a ratio of 40:60 and AAc was introduced having concentration of 1 wt.%. The hydrogel's removability of Methylene blue dye from its aqueous solution was then investigated.From the dye adsorption kinetics it was found that adsorption mechanism follows pseudo 2nd order kinetics. From the effect of initial dye concentrations study, it was found that the highest dye adsorption capacity was around 105 mg/g. The adsorption isotherm studies revealed that the adsorption processes follow Langmuir model.

1.3 Preparation and characterization of PEO, DMA and 2-HEMA blend hydrogel by gamma radiation

M. S. Rahaman, S. M. M. Hasnine, T. Ahmed, S. Sultana and S. Mallick

Hydrogel from Polyethylene Oxide (PEO), N,N-dimethylacrylamide (DMA) and hydroxyethylmethacrylate (2-HEMA) was prepared by gamma radiation at 10 kGy, 15 kGy, 20 kGy, 25 kGy dose from Co-60 gamma source. Concentrations of PEO, DMA were kept constant and 2-HEMA concentrations were varied from 0-3 wt.%. Gel fraction, swelling ratio properties were investigated. It was found that gel fraction increased with increased radiation dose and attained maximum at the radiation dose of 25 kGy, i.e. 95.13742 for PDH0 hydrogel. It was found that the degree of swelling decreased with increasing in radiation dose. The swelling ratio of hydrogels which were irradiated at 10 kGy showed maximum swelling, i.e. 4109.059 and 4144.788 for PDH0 and PDH1 respectively. After that the swelling ratio of the hydrogels decreased successively at higher radiation doses, i.e. 2311.659 and 2390.15 for PDH0 and PDH1 up to 25 kGy.

1.4 Synthesis of PEO, DMA and acrylic acid blend hydrogel by gamma radiation and its characterization

M. S. Rahaman, S. M. M. Hasnine, T. Ahmed, S. Sultana and C. R. Sarker

Hydrogels based on polyethylene oxide (PEO)-N,N- dimethylacrylamide (DMA) grafted with acrylic acid (AAc) (PDA hydrogels) was synthesized from aqueous mixture of constant concentrations of PEO ,DMA and different concentrations of acrylic acid (AAc) using Co-60 γ-radiation source from 10-25 kGy radiation dose at room temperature without using any external cross-linker. The effects of different radiation doses on gel content and swelling behavior were investigated thoroughly. Gel fraction of hydrogel increased with increased radiation dose and attained maximum at the radiation dose of 25 kGy that was 96.1103 for PDA0 hydrogel sample. On the other hand, swelling properties of hydrogel decreased with increased radiation dose that was 22.3129 at 25 kGy for PDA1 hydrogel sample.

1.5 Synthesis and implication of grafted polymeric adsorbent for heavy metal removal

N. Rahman, N. C. Dafader, S. Shahnaz, M. N. Sardar, F. T. Ahmed, A. R. Miah and M. H. Kabir

Nowadays, grafted polymeric composite has received much attention as an alternative adsorbent of heavy metal removal. The grafted polymeric adsorbent (GPA) in the form of composite was prepared using diallyl dimethyl ammonium chloride (DADMAC) and acrylic acid embedded nonwoven irradiated polythene sheet. The prepared GPA was characterized using Fourier Transform Infra-Red (FTIR), Scanning Electron Microscopy (SEM) and Thermogravimetric Analysis (TGA) to understand molecular interaction, surface morphology and physical phenomena of them. The effect of parameters including pH, initial metal concentration, contact time, as well as temperature on the adsorption of Cu/Cr was studied sequentially. The result shows that the GPA had utmost grafting yield of 192% with reaction time 4.0 h at 50 kGy. The maximum adsorption was found up to 153.89 mg.Cu/g and 17.34 mg.Cr/g with an initial concentration of 1000 ppm, a contact time of 24 hr, pH of 4.84 (Cu^{2+}) and 1.5 (Cr) at room temperature ($25^{o}C$) indicating superb synergetic adsorption capacity of the GPA. Comparing the Langmuir and Freundlich adsorption isotherm models, the former showed a higher correlation coefficient (R^2) than the latter implying that the former model can be applied to uptake Cu/Cr by GPA. In the kinetic adsorption experiment, adsorbed metal almost reached equilibrium about 10 h for the GPA and followed the pseudo-second-order kinetic model. Thus, the GPAs are propriety and competent in terms of capability and reusability to remove heavy metal ions.

1.6 Radiation grafting of acrylic acid and sodium styrene sulfonate on non-woven polyethylene fabric and its application in removal of heavy metals from aqueous solution

N. Rahman, N. C. Dafader, S. Shahnaz, M. N. Sardar, F. T. Ahmed, A. R. Miah and M. H. Kabir

Environmental pollution caused by heavy metal effluents is a major concern and treatment of heavy metal effluents before their discharge into the environment is essential. In present study acrylic acid (AAc) and sodium styrene sulfonate (SSS) grafted non-woven polyethylene fabric were prepared by the application of gamma rays from Co-60 source at room temperature. 30 % AAc, 10 % SSS, 4 % NaCl and 0% mohr's salt were selected as the optimum composition for grafting. The radiation dose used was 50 kGy. The graft yield obtained under this condition was 270 %. The grafted fabric was characterized by Fourier Transform Infrared

(FTIR), Scanning Electron Microscopy (SEM) and Thermo-gravimetric Analysis (TGA). The grafted adsorbent was used for adsorption of Pb (II) and Cr (III) from aqueous solution. Adsorption capacity was investigated under different conditions: contact time, pH and initial metal ion concentration. The optimum condition for maximum adsorption was found to be contact time 48 h and initial metal concentration 1000 ppm for all the metal ions studied and pH 6.2 for Pb (II), 5 for Cr (III). Kinetic adsorption data was elucidated using pseudo-first-order and pseudo-second-order equations. The equilibrium experimental data of metal adsorption matched Langmuir isotherm model. From the Langmuir equation, the monolayer saturation adsorption capacity (highest adsorption capacity) of the adsorbent was found to be 38.46 mg/g for Pb (II) and 111.11 mg/g for Cr (III). Desorption and reuses of the films were also successful. The results indicate that the AAc-SSS blend film can be used for cationic metal absorption from industrial waste water for Environ. purification.

1.7 Uranium recovery from aqueous solution using starch-acrylic acid-acrylamide hydrogel prepared by radiation technique

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

Starch Acrylic acid and Acrylamide hydrogel were prepared by the application of gamma rays from Co-60 source at room temperature. The prepared absorbent was used for absorption of uranium (VI). Absorption capacity of the absorbent was studied at different contact time, pH, temperature, concentration of uranium (VI) solution. Absorption of absorbent reaches a maximum values after 5 hours. The absorption capacity was found highest at pH 3.7. The highest absorption capacity found at 1000 ppm concentration. The highest absorption capacity found was 166.84 mg/g. Isotherm and kinetics of U(VI) adsorption was studied. Desorption and reuse of the absorbent was also successful. The results indicate that the starch-acrylic acid-acrylamide hydrogel absorbent can be used for uranium (VI) recovery from sea water and also for U (VI) removal from contaminated water.

1.8 Groundwater quality assessment through irrigation indices in Mubarakganj sugar mills area, Kaliganj, Jhenaidaha

F. T. Ahmed, M. R. K. Milan, M. M. Hossain, M. F. Alam, M. T. Islam, M. O. Rahman and N. C. Dafader

Groundwater is the predominant water resource and is centrally important for human survival and social development all over the world. But with rapid increase in population and growth of industrialization, groundwater quality is being increasingly threatened by disposal of urban and industrial solid waste. In this research work, eleven (11) groundwater samples were collected from 80 - 180 feet depth of different places of Mubarakganj Sugar Mills region, Jhenaidaha. Physical parameters like pH, Electrical Conductivity (EC), Total Dissolved Solids (TDS), Salinity and Turbidity of the samples were measured and the range for pH, EC, TDS, Salinity and Turbidity were 6.598 - 7.209, 299 - 614 μS/cm, 164.45 - 399.1 mg/L, 0.3 - 0.6 ‰, 11.97 - 104.9 NTU respectively. Essential elements like Na, K, Ca and Mg and anions such as NO_3^-, SO_4^{2-}, HCO_3^- and Cl^- were also assessed by Flame Atomic Absorption Spectrophotometer and UV-Visible Spectrophotometer. The average individual concentration of Na, K, Ca and Mg was 25.90, 1.09, 69.65 and 20.50 mg/L respectively. For the anions the mean concentration was 102.36, 2.67, 3.08 and 7.63 mg/L for HCO_3^-, Cl^-, SO_4^{2-} and NO_3^- respectively. To understand the suitability of the groundwater in Mubarakganj Sugar Mill area several irrigation indices like Sodium Adsorption Ratio (SAR), Soluble Sodium Percentage (SSP), Residual Sodium Carbonate (RSC), Magnesium Adsorption Ratio (MAR), Permeability Index (PI), Kelly's Ratio (KR), Potential Salinity (PS) and Chloro-Alkaline Index (CAI-I and CAI-II) were estimated. From these assessments it was seen that, rather than the PI all other irrigation parameters indicate that the groundwater was suitable for irrigation and base exchange was occurred during the water stream (CAI was negative). This study may be helpful in developing an appropriate management plan and sustainable utilization of groundwater for irrigation of that area.

1.9 Non-carcinogenic risk assessment of some heavy metals in energy drinks of Dhaka, Bangladesh

F. T. Ahmed, M. F. Alam, M. T. Islam, N. C. Dafader, M. S. Rahman, G. Ara and M. A. Ali

Energy drinks are non-alcoholic beverages claimed to give extra burst of energy for daily obligation and promote wakefulness and provide cognitive and mood enhancement. Energy drinks generally contain

methylxanthines (including caffeine), B vitamins, carbonated water, guarana, yerba mate, acai and taurine, plus various forms of ginseng etc. Although many energy drinks are promoted as being boosting health or energy but it may in fact have adverse health consequences include insomnia, nervousness, headache and tachycardia. The primary objective of this research is to assess some physico-chemical properties of the energy drinks and to evaluate the associated health risks of heavy metals with the consumption of energy drinks. In this study thirteen (13) energy drink samples were collected from various super shops of Dhaka city and all the physical parameters like pH, EC, TDS and Total acidity has been measured. It has been seen that pH of all the energy drinks are relatively very low which is not suitable specially for our dental health. Heavy metals like Fe, Cu, Zn, Ni, Cd and Cr were measured by Flame Atomic Absorption Spectrophotometer and it was found that Fe, Cd and Ni concentration in all the samples and Cr in most of the samples were much higher than WHO standard values. For the assessment of non-carcinogenic risk, Chronic Daily Intake (CDI), Hazard Quotient (HQ) and Hazard Index (HI) has been evaluated. The HQ and HI of all heavy metals were below 1 for all samples (except for one HQ for Cr and HI of Cr and Cd) but the total HI of the studied element was found 7.88 which is much higher than the standard value (HI<1.0). This high non-carcinogenic factor indicates the different health risks from these drinks for long term intake.

1.10 Study of heavy metals in groundwater of Lakshimur district and assessment of human health risks

F. T. Ahmed, S. Akter, M. M. Kabir, M. T. Islam, G. Ara, M. S, Rahman and N.C. Dafader

The present investigation appraises the spatial variations, pathways of groundwater contamination, associated health risks of trace metals (TMs) at Lakshmipur coastal basin, Bangladesh employing groundwater quality index and health risk assessment. A total 60 triplicate groundwater samples were collected from 60 villages of 20 unions from Raipur and Ramganj upazilas by purposive random sampling method. The mean values of temperature, pH, EC, Cl^-, SO_4^{2-}, Fe, Mn, Cu, Zn, Pb were found within the range of permissible limits, while Cd, Cr and As concentration's exceeded the limits stipulated by both Bangladeshi and international water quality standards. Groundwater quality index revealed that 51.67 % of the water samples belonging to good quality water. The spatial distribution of heavy metal evaluation indices revealed that Raipur upazila of Lakshipur district was comparatively more polluted than Ramganj upazila. The Principle Component Analysis (PCA) identifies four dominant factors, responsible for data structure, explaining 68.282% of total variance in the data set. Correlation coefficient and PCA agrees with CA, suggesting that multiple natural and anthropogenic sources are responsible for the ground water quality deterioration in the study areas. The carcinogenic risks of cadmium (Cd), arsenic (As), lead (Pb) and chromium (Cr) via oral exposure pathway indicated that most of the studied samples were at high risks for both adults and children. It was found that groundwater of both upazilas exhibited high contamination and children are more susceptible to both non-carcinogenic and carcinogenic health risks than adults. From the present study it was evident that dermal exposures showed comparatively lower risk than oral exposures as the mean Hazard Index value of dermal pathway is less than 1 for both age groups.

2. Manpower Development and Training Program

Title of the event	Date	Place	No. of participant
Regional Training Course on Advanced Grafting of Polymeric Materials for Waste Water Treatment	22 - 26 Jul. 2019	Manilla Philippines	01
Training Course on Radiation Protection for Radiation Workers and RCO's of BAEC, Medical Facilities and Industries	15 - 19 Sept. 2019	TI, AERE	01
Follow-up Training Course on Environ. Radioactivity Monitoring Course (ERMC)-2020	12 - 16 Jan. 2020	TI, AERE	02
Follow-up Training Course on Reactor Engineering Course (REC)-2020	09 - 27 Feb. 2020	TI, AERE	01

3. Seminar/Conference/Workshop/Meeting attended

Name of the participant	Title of the event	Organizer	Date	Place
F, T. Ahmed and M. N. Sardar	Bangladesh Chemical Society Conference-2019	Dept. of Chemistry, RU	9 - 10 Nov. 2019	RU
F. T. Ahmed	Conference on Environ. Solutions for Sustainable Development: Towards Developed Bangladesh	Bangladesh Awami League	27 - 28 Nov. 2019	Press Club, Dhaka
Dr. S. Sultana	3rd International Conference on Physics for Sustainable Development & Technology (ICPSDT-2019)	CUET	18 - 19 Dec. 2019	Chattogram
F. T. Ahmed, S. M. M. Hasnine and T. Ahmed	4th Young Scientist Congress on Young Scientist for achieving sustainable development goals	Bangladesh Academy of Sciences	13 - 15 Dec. 2019	Dhaka
F. T. Ahmed and M. T. Islam	International Conference on Earth and Environ. Sciences & Technology for Sustainable Development ICEEST-2020	Faculty of Earth and Environ. Science, DU	25 - 27 Jan. 2020	Inter Continental Hotel, Dhaka
Dr. N. Rahman, F. T. Ahmed, M. N. Sardar and M. T. Islam	International Conference on Recent Advances in Chemistry (ICRAC) - 2020	Dept. of Chemistry, JNU	7 - 8 Feb. 2020	JNU

4. Service Rendered

Name of service	No./quantity of sample
Reactor Coolant Analysis	5 (water samples)
Centre for Research Reactor, AERE	Na, K, Cu, Zn, Fe, Mn, Ni, Cr, Cl^-, HCO_3^-, NO_3^- and SiO_2

Health Physics and Radioactive Waste Management Unit, INST

Objective/Introduction

The objective of Health Physics and Radioactive Waste Management Unit (HPRWMU) is to ensure protection of man and the environment, at present and in future, from hazards & deleterious effects of ionizing radiations associated with Radioactive Wastes (RW) and Radiation Sources (RS). In order to achieve the above mentioned objective, the unit is conducting its activities in the following areas:

- Providing routine and emergency radiation protection service throughout the country for the assessment and control of radiation exposure to he occupational workers and the public
- Radioactivity monitoring in the Environ. samples and dose assessment of natural radioactivity in staple foodstuff
- Performing standardization of radiation monitoring equipments
- Working for safe management of RW and radiation sources including their ultimate disposal.

Activities

1. Research and Development Work(s)

1.1 Evaluation of natural radioactivity in vegetables and estimation of radiological dose to the Bangladeshi population

M. M. Islam and K. Asaduzzaman

Bangladesh, a rapidly growing developing country, is susceptible to pollution via various industrial engagements and associated human activities. One particular concern is the potential impact upon the quality of locally resourced vegetables, that contain important nutrients necessary for good health, forming an essential daily diet item for the people of Bangladesh. As a part of this, it is of importance for there to be

accurate knowledge of radioactive material present in these vegetables, not least in respect of any public health detriment. The concentration of natural radioactivity in vegetable is an important parameter for the determination of population exposure by the ingestion of natural radionuclides during habitual consumption of food. Hence, concentrations of naturally occurring radioactive materials, particularly ^{226}Ra, ^{228}Ra and ^{40}K and its annual effective dose with its stochastic effects were determined in commonly consumed vegetables cultivated in Bangladesh and marketed in Dhaka city. The measurement was performed by gamma-ray spectroscopy using a hyper-pure germanium detector (HPGe). The results showed that the radioactivity in different varieties of vegetable samples varied from 3.39±0.27 to 15.36±0.27 Bq kg^{-1} (Average: 9.1±3.22 Bq kg^{-1}) for ^{226}Ra (^{238}U), 0.76±0.23 to 8.82±0.17 Bq kg^{-1} (Average: 4.85±2.12 Bq kg^{-1}) for ^{228}Ra (^{232}Th) and 618.94±1.59 to 3176.60±1.48 Bq kg^{-1} (Average: 1453.09±680.42 Bq kg^{-1}) for ^{40}K. The daily intake of radionuclides by individuals through the consumption of investigated vegetables ranged from 0.57 to 2.57 Bq day^{-1} with an average of 1.52±0.55 Bq day^{-1}, 0.13 to 1.48 Bq day^{-1} with an average of 0.81±0.36 Bq day^{-1} and 103.55 to 513.45 Bq day^{-1} with an average of 241.17±110.33 Bq day^{-1} for ^{226}Ra, ^{228}Ra and ^{40}K, respectively. Conversely, the estimated effective doses caused by the vegetables consumption were ranged from 57.96–268.82 µSv y^{-1} (average: 156.09±58.01 µSv y^{-1}), 32.02–371.63 µSv y^{-1} (average: 198.73±89.46 µSv y^{-1}) and 234.33–1202.66 µSv y^{-1} (average: 524.80±257.61 µSv y^{-1}) for ^{226}Ra, for ^{228}Ra and ^{40}K, respectively. Unfortunately, these values are somewhat higher than the world average values of 120 µSv y^{-1} for uranium and thorium series radionuclides and 170 µSv y^{-1} for ^{40}K reported by UNSCEAR-2000. The associated life-time cancer risk was estimated and found to be also higher than the tolerable limit of $2.9\times10^{-4}$for radiological risk, thus might have a radiological risk to the people due to consumption of the studied vegetables. Since higher level of radioactive substances in the Environ. media is detrimental, continuous monitoring should be carry out to measure the concentration of radioactivity in vegetables as well as other foodstuffs in order to take necessary radiological actions with the aim of reducing the potential harmful effects of ionizing radiation. The data generated herein can be serve as baseline data and reference information for future radiological changes of different vegetables grown in Bangladesh particularly following the latest (11 Mar. 2011) Fukushima Daiichi, Japan nuclear reactor accident and ongoing nuclear power plant at Rooppur, Pabna, Bangladesh.

1.2 Open beam dosimetric characteristics of True Beam medical linear accelerator with flattening filter (WFF) and flattening filter free (FFF)

K. R. Mani, M. A. Bhuiyan, M. S. Rahman and S. M. A. Islam

True Beam medical linear accelerator is capable of delivering flattening filter free (FFF) and with flattening filter (WFF) photon beams. True Beam linear accelerator is equipped with five photon beam energies (6 FFF, 6 WFF, 10 FFF, 10 WFF, 15 WFF) as well as six electron beam energies (6 MeV, 9 MeV, 12 MeV, 15 MeV and 18 MeV). The maximum dose rate for the 6 WFF, 10 WFF and 15 WFF is 600 MU/min, whereas 6 FFF has a maximum dose rate of 1400 MU/min and 10 FFF with a maximum dose rate of 2400 MU/min. In this report we discussed the open beam dosimetric characteristics of True Beam medical linear accelerator with FFF and WFF beam. All the dosimetric data (i.e. depth dose, cross-linear profiles, diagonal profiles, output factors, MLC transmission, etc) for 6 MV, 6 FFF, 10 MV, 10 FFF and 15 MV were measured and compared with the published data of the True Beam. Multiple detectors were used in order to obtain a consistent dataset. The measured data has a good consistency with the reference golden beam data. The measured beam quality index for all the beams are in good agreement with the published data. The percentage depth dose rate at 10 cm depth of all the available photon beam was within the tolerance of the Varian acceptance specification. The dosimetric data shows consistent and comparable results with the published data of other True Beam linear accelerators. The dosimetric data provide us an appreciated perception and consistent among the published data and may be used for future references.

1.3 Monitoring of radioactivity in Environ. samples

K. Asaduzzaman, M. Begum and M. M. Islam

Since concentration of radioactive substances in the environment is undesirable, continuous assessment of radioactivity levels in various Environ. media is essential in order to take necessary radiological measures (public exposure) with the aim of minimizing the potential harmful effects of ionizing radiation to protect public health against the radiation risk originating from environment. The data generated through this work can be used for future loading/reference.

1.4 Radioluminescence of Ge-doped silica optical fibre and Al_2O_3: C dosimeters

A. K. M. M. Rahman, M. Begum, M. Bregum, H. T. Zubair, H. A. A. Rashid, Z. Yusoff and D. A. Bradley

Using an electron accelerator producing a 6 MV X-ray photon beam several experimentally observed excitation phenomena that are associated with radioluminescence (RL) have been investigated, the signal originating from a Ge-doped silica optical fibre and commercial, nanoDot Al_2O_3: C dosimeters. Using PMMA optical communication fibres the RL signals have been guided from the beam-delivery room out to the readout instrumentation that has been located beyond the concrete maze providing effective radiation shield. Ge-doped silica fibre memory effects and afterglow (phosphorescence) were compared with that of the commercial Al_2O_3: C dosimeter. Immediately following RL, observation was made of the decay curves of the afterglow signal of Al_2O_3: C. Conversely, there was little practically observable afterglow for the Ge-doped fibre used for the majority of present investigations (the dopant concentration of this being 3.6 wt %). Among three different concentration of Ge-doped fibres that were subsequently investigated in a follow-up-study, the intensity of afterglow was found to be greatest for the more highly doped concentration (7.0 wt % Ge), with progressive reduction of the effect for the Ge 4.7 wt % and Ge 3.6 wt % fibres. These observations can be compared against the much more marked RL memory effect observed using the Al_2O_3: C chips. Current results point to the Ge-doped silica optical fibre being a highly promising candidate for real-time RL dosimetry and sensing.

1.5 Evaluation of radioactivity of cultured fishes collected from fish market of Dhaka City

K. Asaduzzaman and M. Begum

This study is targeted at the evaluation of natural radioactivity (natural decay chains of ^{238}U and ^{232}Th and non-series long-lived natural radionuclide ^{40}K) resulting from the consumption of cultured fishes as a staple food of Bangladesh. The studied 15 species of cultured fish samples were collected from fish markets of Dhaka City. The radioactivity concentrations have been measured by γ-ray spectrometry using high resolution high purity germanium (HPGe) detector. The results showed that the radioactivity in different species of cultivated fish samples varied from 0.83±0.38 to 8.50±0.30 Bq kg^{-1} (Average: 4.24±2.35 Bq kg^{-1}) for ^{226}Ra (^{238}U), 0.62±0.30 to 7.41±0.15 Bq kg^{-1} (Average: 3.64±2.19 Bq kg^{-1}) for ^{228}Ra (^{232}Th) and 171.07±1.60 to 513.28±1.59 Bq kg^{-1} (Average: 297.18±80.86 Bq kg^{-1}) for ^{40}K. The estimated effective doses for the respective radionuclides caused by the cultivated fish consumption were ranged from 5.31–54.36 (average: 27.09±15.04), 9.77–116.79 (average: 57.43±34.58) and 24.23–72.69 (average: 42.09±11.45) 120 μSv y^{-1}for for ^{226}Ra, for ^{228}Ra and ^{40}K, respectively. These values are far below than the world average values (120 μSv y^{-1} for uranium and thorium series radionuclides and 170 μSv y^{-1} for non-series ^{40}K reported by UNSCEAR-2000 and the associated life-time cancer risk were also below the acceptable limit of 0.29×10−3 for radiological risk, thus discarding any significant radiological threats to the population of Bangladesh due to consumption of cultivated fish. Since higher concentration of radioactive substances in the environment is undesirable, continuous monitoring should be undertaken to detect the concentration of radioactivity in cultured fishes as well as other foods in order to take necessary radiological actions with the goal of reducing the potential harmful effects of ionizing radiation. It is thus hoped that the present results will help to create a baseline data and reference evidence to assess any radiological loadings of different cultured fishes in future in Bangladesh particularly following the latest (11 Mar. 2011) Fukushima Daiichi, Japan nuclear reactor accident and ongoing nuclear power plant at Rooppur, Pabna, Bangladesh.

1.6 Comparative studies of dose measurements in cornea and mantle shielding block for high energy gamma radiation (^{60}Co) in radiotherapy treatment

M. Shamsuzzaman, M. S. Rahman, D. Paul, M. J. Alam and S. R. Chakraborty

Cornea and Mantle shielding blocks were used to evaluate the dosimetry features of blocked beam radiotherapy. These blocks were used to produce the blocked beams, for 5 × 5 cm^2 and 30 × 30 cm^2 field sizes. Doses were measured and calculated by the Clarkson's method and compared mutually. The variations of 0.05%,0.92% and 0.99% were observed at three dose investigation points of 5 × 5 cm^2 field size for cornea block. For mantle block the variation between measured and calculated values were founds to be 1.97%, 2.46%, 2.39%, 2.13%, 2.00% and 1.93% at six dose investigation points of 30 × 30 cm^2 field size. In

this study dose calculated by the empirical relation using correction factors $C^{i}_{j\times k}$ and CF_i were found approximately equal to the experimental value. In the cases of both cornea and mantle shielding the calculated mean value of uncertainty in dose measurement between calculated dose values of Clarkson's method and empirical relation was found satisfactorily to be within ± 5.0%, fulfilling to the International Commission on Radiation Units and Measurements (ICRU).

1.7 Assessment of radiological impact of indigenous fishes available in fish market of Dhaka city

K. Asaduzzaman and M. Begum

Radioactivity level in human diet is of particular concern for the assessment of possible radiological hazards to human health. Fish is an essential daily diet item and also the staple food for the people of Bangladesh, evaluation of radioactivity in fish is crucial to determine the prevailing radiation dose due to their consumption. A comprehensive study was carried out to determine the radioactivity levels of ^{226}Ra (^{238}U), ^{228}Ra (^{232}Th) and ^{40}K in 15 species of indigenous (non-cultured)fishes available in fish market of Dhaka city by γ-ray spectrometry using high resolution high purity germanium (HPGe) detector. The radioactivity levels of ^{226}Ra, for ^{228}Ra and ^{40}K studied fish samples were ranged from 1.89±0.31 – 10.42±0.29 Bq kg^{-1} with an average of 5.19±2.72 Bq kg^{-1}, 1.19±0.47 – 7.92±0.55 Bq kg^{-1} with an average of 4.76±2.30 Bq kg^{-1} and 107.40±1.60 – 405.88±1.59 Bq kg^{-1} with an average of 290.17±92.32 Bq kg^{-1}, respectively. The annual effective dose for ^{226}Ra, ^{228}Ra and ^{40}K due to consumption of indigenous fishes by the public were assessed and found to be varied from 12.09–66.64 µSv y^{-1} (average: 33.22±17.41 µSv y^{-1})18.82–124.82 µSv y^{-1} (average: 75.03±36.15 µSv y^{-1}) and 15.21–57.48 µSv y^{-1}(average : 41.37±13.22 µSv y^{-1})for ^{226}Ra, for ^{228}Ra and ^{40}K, respectively with a total of 149.62 µSv y^{-1} which is well below the world average of 290 µSv y^{-1}, hence imposes no significant threat to human health. The estimated cancer risk shows that probability of increase of cancer risk from daily intake of vegetables are only a minor fraction of ICRP values 0.29×10−3. Since, higher levels of radioactive substances in the Environ. media is detrimental, regular monitoring should be undertaken to measure the radioactivity levels in foodstuffs including ingenuous fishes in order to take necessary radiological measures with the aim of minimizing the potential harmful effects of ionizing radiation. It is thus expected that the present results will help to establish a baseline data and reference information to assess any radiological loadings of various fishes in future in Bangladesh particularly following the latest (11 Mar. 2011) Fukushima Daiichi, Japan nuclear reactor accident and ongoing nuclear power plant at Rooppur, Pabna, Bangladesh.

1.8 Estimation of average annual committed effective dose due to intake of medicinal plants collected from Chattogram, Bangladesh

D. Paul, M. I. Ali and M. A. Haydar

The natural as well as probable anthropogenic radioactivity in 10 medicinal plants collected from different hilly areas and local markets of Chattogram, Bangladesh were investigated by gamma spectrometry system by using a calibrated High Purity Germanium (HPGe) detector of 20% relative efficiency. The study showed that only naturally occurring radionuclides (e.g., ^{232}Th and ^{40}K) were present in the samples and no artificial radionuclides have been identified in any of the analyzed samples. The activity concentrations of ^{232}Th and ^{40}K were found to be ranged from 8.38 ± 0.78 Bqkg^{-1} to 23.34 ± 0.36 Bqkg^{-1} and 59.66 ± 1.06 Bqkg^{-1} to 241.67 ± 1.06 Bqkg^{-1}, respectively with an average of 14.80 ± 0.64 Bqkg^{-1} and 146.58 ± 1.06 Bqkg^{-1}. Based on the concentrations of the radionuclides, the Average Annual Committed Effective Dose (AACED) were then estimated and found as 0.05 mSv/y and 0.0013 mSv/y, respectively. The AACED due to ingestion of the natural radionuclides in the medicinal plant samples are far below than the world average of 0.3mSv/yr for the same as per UNSCEAR 2000 report.

2. Manpower Development and Training Program

Title of the event	Date	Place	No of participant
Training Course on Health Physics and Radioactive Waste Management activities-1	6 Aug. 2019	HPRWMU, INST	20
Training Course on Health Physics and Radioactive Waste Management activities-2	21 Aug. 2019	HPRWMU, INST	20

Title of the event	Date	Place	No of participant
Training Course on Nuclear Non-proliferation and IAEA Safeguards	11/09/2019	HPRWMU, INST	18
Training Course on Interference Correction of 186.2 KeV Line (^{226}Ra) by 185.7 KeV Line (^{235}U)	23 Sept. 2019	HPRWMU, INST	18
Training Course on HPRWMU-এর গবেষণা সমূহের এক্রিডিটেশন সংক্রান্ত	09 Oct. 2019	HPRWMU, INST	17
Training Course on Current status and future requirement of Gamma Spectrometry System in HPRWMU	22 Oct. 2019	HPRWMU, INST	20
Training Course on HPRWMU-এর শুদ্ধচার কৌশল সম্পর্কিত	30 Oct. 2019	HPRWMU, INST	18
Training Course on HPRWMU-এর শুদ্ধচার কৌশল সম্পর্কিত	06 Nov. 2019	HPRWMU, INST	17
Training Course on Thermoluminescence Characteristics of Tailor-Made Silica Fibers in Medical Dosimetry (Part-1)	11 Nov. 2019	HPRWMU, INST	20
Training Course on Thermoluminescence Characteristics of Tailor-Made Silica Fibers in Medical Dosimetry (Part-2)	21 Nov. 2019	HPRWMU, INST	19
Training Course on Absolute Dosimetr	09 Dec. 2019	HPRWMU, INST	13
Training Course on Relative Dosimetr	15 Dec. 2019	HPRWMU, INST	14
Training Course on In-vivo Dosimetry	24 Dec. 2019	HPRWMU, INST	18
Training Course on Scope of the SSDL Work	19 Jan. 2020	HPRWMU, INST	20
Training Course on Facility Requirements and Bunker Construction	28 Jan. 2020	HPRWMU, INST	17
Training Course on Review of radiation protection and safety in Brachytherapy Unit	04 Frb. 2020	HPRWMU, INST	16
Training Course on HPRWMU-এর শুদ্ধচার কৌশল সম্পর্কিত	04 Feb. 2020	HPRWMU, INST	16
Training Course on Activities of HPRWMU	15 Mar. 2020	HPRWMU, INST	18
Training Course on Commercial Optical Fibre as TLD Material	22 Mar. 2020	HPRWMU, INST	17
Training Course on The Role of HPRWMU Team on Radiation Safety Aspects for Radioisotopes (Tc-99m & I-131) Production at Radioisotope Production Division (RIPD) of INST, AERE	31 May 2020	HPRWMU, INST	17
Training Course on Radiological Safety Culture Analysis Part-2	31 May 2020	HPRWMU, INST	17
Training Course on Basic of Gamma Ray Spectroscopy (HPGe detector)	17 Jun. 2020	HPRWMU, INST	17
Training Course on করোনা ভাইরাস (কোভিড-২০১৯) প্রতিরোধে পালনীয় স্বাস্থ্য বিধি সম্পর্কিত	23 Jun. 2020	HPRWMU, INST	17
Training Course on Radiation detection and measurement	24 Jun. 2020	HPRWMU, INST	17

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

Name of the participant	Title of the event	Organizer	Date	Place
Dr. M .M. Islam	International School of Nuclear and Radiological Leadership for Safety	IAEA and Government of Japan	17-28 Feb. 2020	Tokai University Tokyo, Japan
	Technical Meeting on Global Status of Decommissioning	IAEA	26-30 Aug. 2019	Vienna, Austria
Dr. K. Assaduzzama, Dr. M. H. Bhuyan, Dr. M. Begum, S. Poul,T. Siddiqua and N. Arobi	International conference on Physics in Medicine	BAEC, BMPA & BMPT, DU	6-7 Feb. 2020	DU & AECD
Dr. M. H. Bhuyan M. A. Haydar	International conference on Physics	Bangladesh Physical Society	5-7 Mar. 2020	AECD

4. Stakeholder Meeting

M. Moinul Islam, Session Chair, consolidated report, 02 Oct. 2019, FNCA 2019 workshop on Radiation Safety and Radioactive Waste Management, Hanoi, Vietnam, 1-3 Oct. 2019.

5. Collaboration Work(s)

- INT9186 - IAEA Sustaining Cradle-to-Grave Control of Radioactive Sources
- FNCA project on Radiation Safety and Radioactive Waste Management
- Asian Nuclear Safety Network (ANSN) 'Radioactive Waste Management Topical Group (RWMTG).

6. Lecture Delivered

'Waste Classification, Treatment, Storage and Disposal' Training course on Radiation protection for radiation workers and RCos of BAEC, Medical Facilities and Industries, Training Institute, Savar, Dhaka, 18-09-2019, lecture delivered by Dr. M. Moinul Islam.

7. Others

- Number of Environ. sample analysis: 262
- Number of calibrated radiation measuring devices: 127
- Number radiation survey: 45
- Management of RW: 2
- Preparation of FNCA Consolidated Report 'On general outline and specific site safety assessment of Low Level Radioactive Waste Repository'- (NSRA), Japan, M. Moinul Islam, Mar. 2020.

8. Service Rendered and Revenue Income

No. of service given to the organization	Name of service	No. of sample	Income
9	Radiation survey	15	90000/-
2	Interim storage	2	137511/-
52 (appx.)	Radiation measuring devices calibration, dosimetry	127	460000/-
Total		144	687511/-

Reactor Physics & Engineering Division, INST

Objective/Introduction

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

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 technology
- Neutronics analysis of nuclear reactors
- Thermal hydraulics and Safety studies of nuclear reactors.

2. Manpower Development and Training Program

Title of the event	Date	Place	No. of participant
E-Nothi Training Course	13-16 Oct. 2019	ICS, AERE	01
Training Course on PPR-2008 and Public Procurement Management	20-31 Oct. 2019	TI, AERE	01
Four Lectures delivered for Reactor Engineering Course at BAEC (RECB-8)-2020	09-27 Feb. 2020	TI, AERE	-
In-house Training Course	Jul. 2019-Jun. 2020 (46 Hours)	RPED, INST	9

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

Name of the participant	Title of the event	Organizer	Date	Place
Dr. B. N. Hamid	Technical Meeting on Specific Considerations for the Deployment of Nuclear Cogeneration Projects	IAEA	22-24 Jul. 2019	Vienna, Austria
Dr. M. A. Motalab	Technical Meeting on Computational Benchmarks for Research Reactor Fuel Burnup and Activation Codes	IAEA	02-06 Sept. 2019	Vienna, Austria
Dr. M. J. H. Khan	Regional Training workshop on Phenomenology, Application and Assessment of Passive Systems in Advanced WCRs (RAS2018-1807100)	IAEA	09-13 Sept. 2019	Beijing, China
M. S. Mahmood	State of Art Knowledge of Advanced Nuclear Power Reactor Designs with Educational Tools Supporting Regional Human Capacity Development (RAS 2018-1900270)	IAEA	09-13 Sept. 2019	North Carolina USA
Dr. M. S. Rana	Inspection of the Manufacturing of LTME for the construction of Rooppur Nuclear Power Plant	Russian Federation	29 Oct. 2019 - 20 Jan. 2020	Volgado, Russia
M. A. Hossen	International Conference on Research Reactors: Addressing Challenges and Opportunities to Ensure Effectiveness and Sustainability	IAEA	25-29 Nov. 2019	Buenos Aires Argentina
Dr. B. N. Hamid	3rd International Conference on Physics for Sustainable Development & Technology (ICPSDT-2019)	CUET	18-19 Dec. 2019	CUET
Dr. M. J. H. Khan and S. M. Shauddin	International conference on Physics in Medicine	BAEC, BMPA & BMPT, DU	6-7 Feb. 2020	DU & AECD
Dr. M. J. H. Khan	International conference on Physics	Bangladesh Physical Society	5-7 Mar. 2020	AECD

Tandem Accelerator Facilities Division, INST

Objective/Introduction

A 3 MV Tandem Accelerator was installed at the campus of Atomic Energy Research Establishment (AERE) of Bangladesh Atomic Energy Commission in Savar in 2010. The use of low-energy charged particle accelerator in

nuclear research is of high significance, both with regard to fundamental nuclear investigations and to provide valuable data/information for various fields of applied sciences, to study various Environ. pollution studies. Among the latter category, analytical techniques like PIXE (Particle Induced X-Ray Emission) and Rutherford Backscattering (RBS) are well established. With regard to fundamental studies, investigation of nuclear reactions using modern high quality detectors and electronics system is gaining new interests.

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 radiological effects around a nuclear power plant
- To help students to obtain academic degrees.

Activities

1. Research and Development Work(s)

1.1 Elemental analysis using PIXE technique

The main objective of establishing the Tandem Accelerator Facility is to provide analytical service: qualitative and quantitative analysis of elements in Environmental samples, i.e. soil, water, air, food, blood, industrial materials, etc. In this division the following researches are carried out using PIXE technique:

- Investigation of elemental and radiological contamination of soils in shipyards
- Study of soil samples and tree bark in ship breaking area to Environ. pollution due to ship breaking activities
- Determination of lead contamination in human body by analyzing blood samples
- Analysis of elemental profile of available medicinal plants at Savar, Dhaka
- Studies of essential and trace elements in some fruits and vegetables of southwestern Bangladesh.

1.2 Radionuclide research and development studies under bangladesh-usa-german Cooperation

Bangladesh-USA-German Cooperation has been established for Radionuclide Research and Development Studies, in particularly to develop 86Y radioisotope. The radionuclide ^{86}Y(T1/2=14.7 h; Iβ+=33%; Eβ+=1.2 MeV) is a well-developed positron emitter, forming a theranostic pair with the therapeutic radionuclide 90Y (T1/2=2.7 d; $I\bar{\beta}$ =100 %; $E\bar{\bar{\beta}}$ = 2290 keV). The radionuclide 90Y is commercially available. The production of 86Y via 86Sr(p,n)-reaction is also fairly well established. The nuclear reaction cross section database, however, is weak. It is therefore planned to measure the cross section data with a higher accuracy, partly to improve the database, but also from mechanistic point of view.

Six irradiations of the86Sr-containing stacks were carried out with protons. Two irradiations were performed with protons of primary incident energy of 45±0.2 MeV at JULIC cyclotron at FZJ, Germany. One irradiation with 27±0.3 MeV primary energy protons was carried out at the 88-inch Cyclotron, Lawrence Berkeley National Laboratory (LBNL), USA. The other three stacks were irradiated with 16.7±0.2 MeV primary energy protons at the BC 1710 cyclotron at FZJ, Germany. After gamma-ray counting, spectra were transferred in the laboratory of Tandem Accelerator, AERE, Savar and analyzed here.

During proton irradiations of a 86Sr target, besides 86Y, several other short-lived isomeric states of neutron deficient isotopes of yttrium are also formed. It is intended to measure the isomeric cross section ratios in those cases. The results should shed some light on the effect of nuclear spins and angular momentum distribution on the formation of the isomeric states.

1.3 Integral measurement of spectrum-averaged cross sections by fast neutrons of a TRIGA reactor

Integral cross sections of the reactions 24Mg(n,p)24Na, 27Al(n,p)27Mg, 27Al(n,α)24Na, 58Ni(n,d + np)57Co and 60Ni(n,p)60Co were measured for the first time using the fast neutron spectrum of a TRIGA reactor extending from 0.5 to 20 MeV. The values obtained in this work were comparable with the recommended

values for a pure 235U prompt fission spectrum. The measured integral value was utilized for integral test of excitation function of each reaction given in some data libraries, namely ENDF/B-VIII.0, TENDL-2017, IRDFF-1.05 and ROSFOND-2010. The integral measurements are generally consistent with the integrated values within 5 %, except for a few cases, e. g. the reaction ^{60}Ni(n, p)^{60}Co, where the data libraries appear to need improvement.

2. Repair & Maintenance and Renovation Works

- Regular maintenance of 40 KVA main UPS and 1500 VA control room UPS
- Maintenance of 358 Duoplasmatron ion source by dismantling, cleaning, aperture change, wire cover replacement and electrical connection soldering
- Fixing the problems in power supply control unit of 358 Duoplasmatron ion source by replacing two burnt tantalum capacitors
- MPI, LE and HES CANNODEs missing problems are fixed by re-soldering optical T/R cards
- Adjustment of ADC threshold and amplifier gain to get better resolutions of detectors
- Fixing the problems in PS4 PLC unit of DILO system
- Urgent gas recovery from Accelerator Tank is completed manually bypassing PLC based PS4 auto unit using DILO system
- Cleaning, repair and maintenance of 860C negative sputter ion source
- Fixing the problems in power supply unit of 860C negative sputter ion source by replacing one transformer and two diodes
- Fixing the problem of Accelerator Tank pressure mechanical sensor switch by resetting the pressure value
- Vacuum conditioning of PIXE and PIGE detector by special vacuum attachment supplied by IAEA expert to improve the resolution
- Testing the data acquisition system using pulser
- Red LED blinking on output display board of LE CANNODE are fixed by scouring of EPROM board by multimeter probe
- Fixing the problems in DD9 Filter kit and automatic drain kit of Air compressor
- Switch interlock system attached with movable HPGe PIXE detector is fixed by connecting all wires properly using circuit diagram supplied from HVEE
- Design, construction and high vacuum testing of new attachment (reducer and collimator with aluminum foil) for external PIXE set up.

3. Manpower Development and Training Program

Title of the event	Date	Place	No. of participant
In-house training course on Beam Isolation Valves, SF_6 Gas Leak Detector, Radiation Safety and Survey Meters	1-3 Jul. 2019	TAFD, INST	13
In-house training course on Cooling Water Circulating System, Rotary Pumps and Their Maintenance and Amplifier Operation	4-6 Aug. 2019	TAFD, INST	09
In-house training course on Central AC, Turbo Molecular Pumps and PIXE Detector	1-3 Sept. 2019	TAFD, INST	12
In-house training course on Diesel Generator, Vacuum Gauzes and Opening and Closing of Tank	1-3 Oct. 2019	TAFD, INST	09
In-house training course on Stripper Section of the Accelerator, Overhead Crane System and Turbo Drives	3-5 Nov. 2019	TAFD, INST	08
In-house training course on PIGE Detector, Accelerator Driver and ADC Operation	2-4 Dec. 2019	TAFD, INST	10

Title of the event	Date	Place	No. of participant
In-house training course on Duoplasmatron Ion Source, Negative Sputtering Ion Source and Bias Supply	5-7 Jan. 2020	TAFD, INST	12
In-house training course on Steerer System, Compressed Air System and Injector Magnet	2-4 Feb. 2020	TAFD, INST	12
In-house training course on Accelerator Tube, Radiation Survey Meter and Sample Holder	2-3 Mar. 2020	TAFD, INST	09

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

Name of the participant	Title of the event	Organizer	Date	Place
M. S. Uddin	Alexander von Humboldt Research Fellow	Research Centre Juelich	2 Sept.- 29 Nov. 2019	Germany
M. M. Hasan	Training on Accelerator/Vacuum	Ruder Boskovic Institute and IAEA	23 Sept. -22 Nov. 2019	Zagreb, Croatia
M. A. Hossain	Training on Accelerator/ Maintenance	Ruder Boskovic Institute and IAEA	23 Sept. -22 Nov. 2019	Zagreb, Croatia
M. Hasan	FIHRDC/WERC Accepting Program for Overseas Researchers and Research Students of Atomic Energy FY2019	Wakasa Wan Energy Research Center	6 Nov. - 24 Dec. 2019	Fukui, Japan

5. Collaboration Work/MoU

IAEA-TC PROJECT: BGD 0010, Strengthening Capacity in the Maintenance and Utilization of the Tandem Accelerator Facility, Period: 1-1-2018 to 31-12-2020

Isotope Hydrology Division, INST

Objectives/ Introduction

- Investigations of surface-water and groundwater resources: their origin, dynamics, interrelations and residence time
- Studying water resources contamination issues like pollution, source and transport of contaminants
- Studying the recharge mechanism of groundwater, flow dynamics and hydraulics and possible interconnection between different aquifer systems using Environ. tracers (stable isotopes $\delta^{2}H$ & $\delta^{18}O$ & radioactive ^{3}H & ^{14}C)
- Determination of groundwater parameters such as direction of groundwater flow, filtration velocity, vertical flow velocity, permeability, effective porosity and dispersion coefficient by single-well dilution technique.

Activities

1. Research and Development Work(s)

1.1 Investigation of groundwater recharge mechanism and flow dynamics of As and Fe in aquifers of Barind Area through Isotopic techniques

M. M. Karim, M. Moniruzzaman, M. A. Q. Bhuiyan, M. A. Ahsan, A. H. A. N. Khan and F. Islam

Barind areas (Chapainawabganj, Noagaon and Rajshahi districts) are highly vulnerable in terms of declining groundwater trends use to the increased population, expansion of farming works and decreased surface water flow in Bangladesh. Several reports claimed that, the underground water table is going down by 1 to 2 feet every year in some parts of this area. Along with declining water table, pollution from Arsenic and Iron is another major concern in Barind tracts. People are suffering from health problems posed by the presence of these elements in excess rate in GW. The main objectives of the research are investigation of groundwater recharge mechanism and aquifer connectivity by stable and radioactive isotopic techniques, drinking water

quality assessment of the study area, health risk assessment and hazard Mapping, source of contaminant investigation. The key outputs will be as follows- knowing the recharge mechanism will help in better aquifer management and groundwater abstraction planning for irrigation and drinking, identification of safe drinking aquifers will be possible, hazard maps will facilitate knowledge for taking preventive measures and validation of ongoing managed recharged aquifer projects.

1.2 Hydrochemical and isotopic characterization of precipitation over Bangladesh

M. M. Karim, M. Moniruzzaman, M. A. Q. Bhuiyan, M. A. Ahsan, A. H. A. N. Khan and F. Islam

The rainwater compositions play an important role in scavenging soluble ionic components from the atmosphere and helping to understand the relative contributions of different sources of atmospheric pollutants. It has a complex chemical composition that varies from place to place and season to season. It contains varying amounts of major ions viz. fluoride, chloride, nitrate, bicarbonate sulfate, sodium, ammonia, potassium, magnesium and calcium. Presence of unwanted components like Cr, Pb and Oxides of Nitrogen and Sulfar indicate the degree of pollution that has occurred to the air of a specific area due to urbanization and industrialization. Moreover, isotopic techniques may help to confirm the source of pollution in precipitation/air and moisture flux propagation. The main objectives of the research are continuous monitoring of rainwater quality in different parts of Bangladesh, complete hydrochemical assessment of rainwater and investigation of moisture source during different seasons of the year through isotopic techniques. The key outputs will be as follows- baseline data representing the present state of air/rainwater pollution, assessment of Environ. abuse and associated health risks and identification of pollutant and moisture propagation.

1.3 An assessment of groundwater quality of Savar upazila and Manikganj district, Bangladesh

M. M. Karim, M. Moniruzzaman, M. A. Q. Bhuiyan, M. A. Ahsan, A. H. A. N. Khan and F. Islam

Industries like tannery, fertilizer, pulp and paper, textile, sugar etc. pose serious Environ. threats by discharging liquid effluents and solid wastes directly into surrounding low lying areas without proper treatment. More than 200 rivers of Bangladesh directly or indirectly receive a large quantity of untreated industrial wastes and effluent. Manikganj district is featured with many industries, e.g. tannery, fertilizer and textile. So, untreated wastes from these industries may cause serious degradation of the surface water and consequently will pollute the groundwater system. By Jun. 2017 about 35% tanneries have been shifted to Savar from Hazaribagh. The allegation of untreated water being released from the new tannery park at Savar on the outskirts of the capital into the nearby Dhaleshwari River is indeed worrying. This proposed investigation will be carried out with the objective of determining the extent of groundwater pollution caused by tanning industries and solid waste dumping in and around the Manikganj District. The main objectives of the research are determination of the extent and level of pollution in multi-aquifered groundwater system, identification of the source point of pollutant/heavy metal release through isotopic techniques, study on interaction between surface water bodies and groundwater and health risk assessment. The key outputs will be as follows- baseline data will be prepared to compare with future pollution scenario, identification of safe/polluted drinking aquifers will be possible and hazard maps will facilitate knowledge for taking preventive measures.

2. Repair & Maintenance and Renovation Works

2.1 Maintenance of the detector of ion chromatograph

For measuring seven major anions in liquid samples an Ion Chromatograph (model: DIONEX ICS-3000, SP) instrument has been used since 2008. There was a problem for producing conductivity signals and stable acquisition was also not established while analyzing samples. The ionic salt solution was clogged while passing through the IC detector which ultimately damaged the whole function of the detector. The IC detector was then replaced and general machine maintenance was done accordingly. The instrument is now functioning properly.

2.2 Repairing of sealed battery of the LWIA (liquid water isotope analyzer) LGR machine

The LWIA (Liquid Water Isotope Analyzer) LGR instrument (model: LWIA-24-EP) of Isotope Hydrology Lab is used to analyze the stable isotopes ($\delta^{2}H$ & $\delta^{16}O$) of water samples. Recently the software of the LWIA generating time anomalies in the final result of analysis report thus many csv files of the database were

vanished. The instrument has been opened and checked and finally found the faulty sealed battery in the motherboard. The problem was then resolved by replacing the old battery with a new one and sealed it with the motherboard by using a heat-gun. The time anomalies in the LWIA software was already resolved and missing csv files were recovered and it is now functioning properly.

2.3 Cleaning and regular maintenance of UV spectrophotometer

The UV-visible spectrophotometer (model: Hach DR-4000) of Isotope Hydrology Lab which is used for analyzing anions, SiO2 and COD got trouble on λ-calibration. The absorption filter was contaminated with microorganisms thus the filers were not functioning properly. For the disinfection and decontamination of the absorption filters, it was cleaned with a cloth moisturized with a mild cleaning agent followed by diluted alcoholic substance i.e. Isopropyl Alcohol. The problem was resolved.

3. Manpower Development and Training Program

Title of the event	Date	Place	No. of participant
15th Training Course on Oceanography: Principles & Applications	23 Feb.- 13 Jul. 2019	NOAMI, Dhaka	1
2019 TPE Science & Technology Training	12 Aug.-23 Aug. 2019	Chengdu, China	1
PPR 2008 and Public Procurement Management	15-26 Sept. 2019	BIM, Dhaka	1
Training Course on PPR-2008 and Public Procurement Management	20-31 Oct. 2019	TI, AERE	1
Follow-up Training Course (FTC) "Radioactive Emergency Preparedness Course"	24 Nov.- 5 Dec 2019	TI, AERE	1
Follow-up Training Course (FTC) on Environ. Radioactivity Monitoring Course	12-16 Jan. 2020	TI, AERE	1

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

Name of the participants	Title of the event	Organizer	Date	Name of the participants
M. M. Karim, M. Moniruzzaman, M. A. Q. Bhuyian, M. A. Ahsan and A. H. N. A. Khan	Bangladesh Chemical Congress 2019 (BCC2019)	Bangladesh Chemical Society	09-10 Nov. 2019	RU
	International Conference on Earth and Environ. Sciences & Technology for Sustainable Development ICEEST-2020	Faculty of Earth and Environ. Science, DU	25-27Jan. 2020	Inter Continental Hotel, Dhaka
M. A. Q. Bhuyian, M. A. Ahsan, A. H. N. A. Khan and F. Islam	Conference on Environ. Solutions for Sustainable Development: Towards Developed Bangladesh	Bangladesh Awami League	27-28 Nov. 2019	Press Club, Dhaka
M. Moniruzzaman, M. A. Q. Bhuyian, M. A. Ahsan and A. H. N. A. Khan	International conference on Physics	Bangladesh Physical Society	5-7 Mar. 2020	AECD
A. H. N. A. Khan	Meeting for Evaluation of Inception Reports for High Power Research Reactor Installation Project	BAEC	18 Jun. 2020	CRR, AERE

5. Collaboration Work

- **IAEA, RCA project RAS7035**

  "Enhancing Regional Capability for the Effective Management of Groundwater Resources Using Isotopic Technique", Period: 2020/2021

- **Memorandum of Understanding (MoU) between INST, BAEC and ITP, CAS**

  Revised and extended MoU have been signed on 27 Mar., 2018 between INST (Director: Dr. Nirmal Chandra Dafadar), BAEC and ITP (Director: Prof. YAO Tandong), CAS at gamma-conference room, BAEC Headquarter, Dhaka, Bangladesh, Period: 5 years (2018-2023)

Reactor and Neutron Physics Division, INST

Objective/Introduction

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 Distribution and contamination of trace elements in surface sediments of the Karnaphuli river using neutron activation analysis

M. A. Islam, R. Das, K. Naher, R. Khan, U. Tamim, S. M. Hossain, M. A. Azam, M. A. A. Talukder, I. Khalil, M. S. Islam, M. S. Uddin and M. A. Rashid

The present study investigates the distribution and contamination of trace elements in surface sediments collected from 10 different locations of the Karnaphuli river. Total concentrations of 23 major and trace elements (Na, Al, K, Sc, Ti, V, Cr, Mn, Fe, Co, Zn, As, Rb, Cs, La, Ce, Sm, Eu, Dy, Yb, Hf, Th and U) in surface sediments of the Karnaphuli river were determined by neutron activation analysis (NAA) method. When compared with upper continental crustal (UCC) values, it is observed that mean concentrations of Ti, V, Cr, Fe, Zn, As, Rb, Cs, La, Ce, Sm, Eu, Dy, Yb, Hf, Th and U show elevated values with respect to UCC values in the sediments of Karnaphuli river. This study will be helpful to quantify levels of trace elements pollution, to identify their tentative sources as well as to mitigate future pollution risks of the river.

1.2 Trace element concentration trends in sediment cores of the Sundarban mangrove forest, Bangladesh

M. A. Islam, M. R. Ali, K. Naher, R. Khan, U. Tamim, S. M. Hossain, M. A. Azam, M. A. A. Talukder, I. Khalil, M. S. Islam, M. S. Uddin and F. Nahid

This research was conducted to reveal the concentration variations of twenty major and trace elements (Al, K, Ca, Sc, Ti, V, Cr, Mn, Fe, Co, As, Br, Sb, Cs, La, Ce, Sm, Yb, Th and U) and their contamination levels using two sediment cores from two different Ranges (C1 in Chandpai Range and C2 in Burigoalini Range) of the Sundarbans mangrove forest, Bangladesh. For quantification of the elements by Neutron Activation Analysis (NAA), samples along with the certified reference materials were irradiated in rabbit irradiation facility of 3 MW TRIGA MARK-II research reactor of Bangladesh Atomic Energy Commission (BAEC) and gamma-ray spectrometry of the irradiated samples was performed using high resolution HPGe detector system. In this study, quality of the analyses was evaluated by analyzing certified reference materials IAEA-SL-1 (lake sediment), IAEA-Soil-7 and NIST-1633b (coal fly ash). It was observed that there was a decreasing trend in concentrations of most of the studied elements from surface to the deeper samples and the rate of concentration decrement of second core (C2) was less than that of the first core (C1), indicating more anthropogenic effect on the Chandpai range near Mongla Sea Port area than the core in Burigoalini Range. The Enrichment factor (EF) values of As, Sb, Cs, La, Ce, Sm, Eu, Yb, Th and U were from 1.5 to 3 showed the evidence of minor modification of these elements whereas Br indicates higher enrichment in the sediment cores. The Pollution Load Index (PLI) for both of the cores suggested deterioration of the sediment quality at the studied region of the Sundarban.

1.3 Elemental analysis of Dhaleshwari river sediments along the tannery industries, Savar, Dhaka

R. Khan, M. N. Ahmed, A. H. M. Saadat, Y. F. Chowdhury, M. A. B. Siddique, K. Naher, M. A. Islam, S. Das, U. Tamim, S. M. Hossain, M. A. Azam, M. A. Ali, M. A. A. Talukder, I. Khalil, M. S. Islam and M . S. Islam

Sediments samples of Dhaleshwari river along the tannery industries were analyzed to study the elemental abundance by using instrumental neutron activation analysis (INAA) at Bangladesh Atomic Energy Commission. In twenty-five sediment samples 30 elements (Na, Al, K, Sc, Ti, V, Cr, Mn, Fe, Co, Ni, Zn, As, Rb, Sb, Cs, Ba, La, Ce, Nd, Sm, Eu, Tb, Dy, Yb, Lu, Hf, Ta, Th and U) were determined. Pollution level and the origin of pollutants were evaluated by the aid of geo-accumulation index (I_{geo}), enrichment factor (EF), pollution load index (PLI) and the inter-element correlation analysis. Major elements are somehow buffered even though the pollution level is severe while the trace metals seem to be highly responsive. Among the metals, Cr is the dominant pollutant, though the pollution level varies systematically with the sampling depth and the distance from the contamination source. Positive linear correlation between Cr and Zn (0.87) ensures the similar anthropogenic source(s) for these two metals, but the sediments of this study respond differently depending upon their geochemical behavior. Rare earth elements (here Sc, La, Ce, Nd, Sm, Eu, Tb, Dy, Yb and Lu), Th and U seem to have crustal origin

1.4 Monitoring of Environ. radioactivity as a signature of anthropogenic pollution

R. Khan, M. N. Ahmed, A. H. M. Saadat, Y. F. Chowdhury, M. A. B. Siddique, K. Naher, M. A. Islam, S. Das, U. Tamim, S. M. Hossain, M. A. Azam, M. A. Ali, M. A. A. Talukder, I. Khalil, M. S. Islam and M. S. Islam

The distribution of naturally occurring radionuclides ^{226}Ra, ^{232}Th and ^{40}K in the sediments of Dhaleshwari river from upstream and downstream of the direct discharge point of tannery industry were determined using gamma ray spectroscopy to examine the probable anthropogenic alteration of the natural radionuclides distribution in the surrounding environment. Since natural distribution of radium equivalent activity, Raeq of radionuclides found to be homogeneous in the environment, any alteration in this homogeneity might be considered as an indicator of anthropogenic influence in that environment. 25 Sediment samples were collected from 5 locations of the river around the tannery industries where it was found that the activity concentrations of ^{226}Ra, ^{232}Th and ^{40}K were lower at the direct discharge point location as compared to the locations at the upstream and downstream of the river. The average values of Raeq 208.13 Bq.kg^{-1}, 131.18 Bq.kg^{-1}, 207.01 Bq.kg^{-1}, 210.91 Bq.kg^{-1} and 208.69 Bq.kg^{-1} respectively at five locations showed homogeneity except for the value at the direct discharge point (131.18 Bq.kg^{-1}). This indicates the fact that anthropogenic activities may have been altering the distribution of naturally occurring radioactive materials.

Neutron Radiography

1.5 Investigation of different woods as neutron radiation shielding materials

R. Barman, R. A. Ramon and S. Islam

As nuclear technology advances and is widely used in today's industries, more people are likely to be exposed to ionizing radiation. A shielding is needed to absorb and reduce the intensity of the radiation. It is one of the protection methods recommended by the International Commission of Radiation Protection (ICRP), other than minimizing operation time and maximizing distance. It requires a more careful design as it is usually permanent and not easily replaceable. Besides, it also needs to be able to fulfill other design requirements depending on where the shield is applied such as heat resistance and structural integrity. The role of neutron shielding is the thermalisation of fast neutrons by elastic scattering with hydrogen or other light elements and capture of thermalised neutrons by high absorption cross section boron or lithium additivation depending on the shielding material used. In the present study, thermal neutron beam at tangential beam port of 3MW BAEC TRIGA research reactor has been utilized to determine the neutron shielding behavior of different wood samples. Six types of wood samples have been investigated and wood sample-6 from Akashmoni tree has been found to be more suitable as shielding materials than other samples. It has also been found that wood sample-4 from Mango tree has lower percentage of neutron stoppage per unit volume and weight than the others which makes it less suitable for shielding materials.

1.6 Visualization and quantitative measurement of unidirectional water absorption by cement mortar with 0.6 and 0.7 w/c

R. A. Ramon, R. Barman, S. Saha, M. N. Islam and M. S. Islam

Building structures made with cementitious materials are generally exposed to environments with variable humidity conditions. Service life of building structures like concrete and mortar is often Ltd. by the penetration of water. Ingress of harmful substance into the matrix is related to the ingress of water, as many aggressive substances are transported by water. Therefore, durability is obtained by decreasing the depth and the rate of moisture ingress through the porous building structures. Neutron radiography can detect water within concrete or mortar with a high sensitivity. In this work, thermal neutron beam at tangential beam port of 3MW BAEC TRIGA-II research reactor was used for neutron radiography. Visualization and quantitative analysis of water absorption into two mortar samples has been accomplished non-destructively using neutron radiography facility.

Neutron Scattering

1.7 Structural properties of copper doped barium zirconium cerate

S. Hossain, I. B. Elius, J. Maudood, M. S. Islam, M. A. Hai and F. Ahmed

The materials of $BaZr_{0.2}Ce_{0.8-x}Cu_xO_{3-\delta}$ (x = 0.15, 0.20, 0.25); three samples named as BZCC1, BZCC2 and BZCC3 were synthesized by the standard solid state reaction method. All the samples were sintered at 1200 °C for 4 hours in air atmosphere. Structural studies have been investigated by X-Ray Diffraction (XRD), Scanning Electron Microscopy (SEM) and Thermo-Gravimetric Analysis (TGA). The X-ray diffraction pattern showed that all the samples possess single phase cubic crystal symmetry with *Pm-3m* space group. The samples were indexed with the help of the Checkcell software and the Rietveld refinement of the XRD data was done by using the Fullprof suite program. The lattice parameter 'a' was calculated and was found to be 3.0853 Å, 3.0686 Å and 3.0663 Å respectively. From the SEM analysis it was found that the densities of the material increase with increasing the copper. The average grain size for the samples BZCC1, BZCC2 and BZCC3 were found to be 2.289 μm, 2.099 μm and 2.007 μm respectively. The TGA measurement was performed under nitrogen atmosphere from 20 °C temperature to 800 °C which revealed that all the samples exhibited high thermal stability up to 800 °C. So, the materials can be a suitable candidate for application in solid oxide fuel cell (SOFC).

1.8 Preparation of $SrNd_{0.65}Zr_{0.35}O_{3-\delta}$ and studies the crystalline parameters by x-ray diffraction

J. Maudood, I. B. Elius, S. Hossain, M. S. Islam, M. A. Hai and F. Ahmed

The purpose of this research is to synthesis and characterizations of $SrNd_{0.65}Zr_{0.35}O_{3-\delta}$ (SNZ) perovskite material. The material has been synthesized by the conventional solid-state reaction method and sintered at 1300 °C in air atmosphere with the heating and cooling rate of 5 °C min^{-1} for 12 hours. The structural and crystalline parameters of the material were studied by X-ray diffraction (XRD) method. The Reitveld refinement of XRD data was done by the Fullprof suite program and confirmed as single phase cubic fluorite perovskite structure with Fm-3m space group. The cell parameters of the sample is found to be a = b = c = 5.252509 Å ($\alpha = \beta = \gamma = 90°$). The composition converged in a perfect χ^2 value after the Rietveld refinement.

2. Manpower Development and Training Program

Title of the event	Date	Place	No. of participant
Internship program for the undergraduate students of Chemistry Dept. of Mawlana Bhashani Science and Technology University	Jul. 2019	RNPD, INST	04
Internship program for the undergraduate students of Chemistry Dept. of Mawlana Bhashani Science and Technology University	Sept. 2019	RNPD, INST	02
Industrial attachment training program for the undergraduate students of Nuclear Engineering Dept. of Dhaka University	Dec. 2019	RNPD, INST	02

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

Name of the participant	Title of the event	Organizer	Date	Place
Dr. K. Naher	FY2019 FNCA workshop on Research Reactor utilization project	NSRA, MEXT	10-12 Sept. 2019	Kurchatov, Kazakhstan
Dr. M. A. Islam	3rd meeting of the FNCA Project on Climate Change using Nuclear and Isotopic Techniques	NSRA, MEXT	7-10 Oct. 2019	Kyoto and Tsuruga, Japan
Dr. R. Khan	Training fellowship at Chinese Academy of Agricultural Sciences, People's Republic of China	IAEA	23-27 Sept. 2019	Chinese Academy of Agricultural Sciences, People's Republic of China
Dr. S. Hossain	Instructor Training Course: Reactor Engineering-I (Nuclear Reactor Physics)	JAEA	19 Aug.-11 Oct. 2019	JAEA, Tokai-mura, Japan
	Conference on Environment Solutions for Sustainable Development: Towards Developed Bangladesh	Bangladesh Awami League	27 - 28 Nov. 2019	DU and CIRDAP
	BAS 4th Young Scientist Congress	Bangladesh Academy of Sciences	13-15 Dec. 2019	National Science Museum, Dhaka
	International conference on Physics	Bangladesh Physical Society	5-7 Mar. 2020	AECD
Dr. K. Naher, Dr. M. A. Islam, Dr. R. Khan, Dr. S. Hossain, I. B. Elius and R. A. Ramon	BAEC & KAERI Workshop on Proposed High Power RR Project	BAEC & KAERI	15-17 Feb. 2020	CRR, AERE
R. Barman	Training Course on Radiation Protection for Radiation Workers and RCOs of BAEC, Medical Facilities and Industries	BAEC	15-19 Sept. 2019	TI, AERE
	Training Workshop on the Advanced use of Neutron Imaging for Research and Applications	IAEA & KAERI	23-27 Sept. 2019	KAERI, Korea
J. Maudood and R. A. Ramon	Follow-up Training Course on Nuclear and Radiological Emergency Preparedness	BAEC & JAEA	24 Nov. - 05 Dec. 2019	TI, AERE
M. S. Islam	Follow-up Training Course on Environ. Radioactivity Monitoring	BAEC & JAEA	12-16 Jan. 2020	TI, AERE
M. S. Islam and R. A. Ramon	Follow-up Training Course on Reactor Engineering	BAEC & JAEA	9-27 Feb. 2020	TI, AERE

4. Collaboration Work/MoU

Collaboration with

- Sunway University, Malaysia
- Indian Institute of Technology, Kharagpur, India
- Prince of Songkla University, Thailand

- Suez Canal University, Egypt
- University of Brunei Darussalam, Brunei Darussalam
- University of St. Andrews, UK
- University of Dhaka, Bangladesh
- Military Institute of Science and Technology, Bangladesh

5. Others

Actively participated to the FNCA projects

INSTITUTE OF ELECTRONICS (IE), AERE

General Electronics Division, IE

Objective

This division deals with the design, development and fabrication of electronic and nuclear instruments which are mainly used for test and measuring purposes. A number of 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 of the country.

Activities

1. Research and Development Work(s)

1.1 Microcontroller based portable radiation dose rate meter (MDGE)

Microcontroller based Portable Radiation Dose Rate Meter (MDGE) has been designed and developed with analog display and working satisfactorily in several institutes. Development work is going on.

1.2 Microcontroller based hand foot and cloth contamination monitor

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 design and fabricated and working satisfactorily. Development work is going on.

1.3 Design and development of a microcontroller based temperature control system

It is a customized instrument which is used to control the temperature of a room for research purpose. The design of the instrument is going on.

1.4 Design and development of a microcontroller based light 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 Laboratory scale. To operate this scale a Laboratory Power Supply has been designed and developed in GED. The instrument is working satisfactorily.

1.6 Software Development

The software development of microcontroller based instruments is going on.

2. Production Works

- Portable radiation dose rate meter, model: MDGE-11, serial no: 071901, sold to Delta Hospital, Mirpur, Dhaka
- Portable radiation dose rate meter, model: MDGE-11, serial no: 101901

3. Repair and Maintenance work

- Repaired portable radiation dose rate meter, model: DRGE-31, serial no: 090402, IFRB, AERE
- Repaired hand foot and cloth contamination monitor, model: HFCMIE-31, serial no: 090901, beneficiary: NINMAS, BSMMU

- Repaired portable radiation dose rate meter, model: DRGE-31, serial no: 031601, Abul Khair, Steel Ltd., Savar at Jan. 2020.

4. Electronic Re-Calibration of Radiation Instruments

- Portable radiation dose rate meter, model: DRGE-31, serial no: 090402, IFRB, AERE, Savar, has been at 25 Sept. 2019
- Portable radiation dose rate meter, model: DRGE-31, serial no: 030701, Beneficiary: Abdul Monem Beverage Ltd. (Coca-Cola), at 8 Oct. 2019
- Hand foot and cloth contamination monitor, model: HFCMIE-31, serial no: 090901, Beneficiary: NINMAS, BSMMU, Dhaka, at Oct. 2019
- Portable radiation dose rate meter, model: DRGE-31, serial no: 031601, Beneficiary: Abul Khair Steel Ltd., at Feb. 2020.

5. Lecture Delivered

- Scientists and Engineers of this division supervised two B.Sc.students of Nuclear Engineering Dept. of Dhaka University from 10-30 Dec., 2019
- The scientists/Engineers of this division delivered lectures in the Industrial Attachment Training Program from 02 Feb' 2020 to 15 Mar. 2020, for the students of different Polytechnic Institute of Bangladesh.

6. Manpower Development/Training Program(s)

Name of the participant	Title of the event	Organizer	Date	Place
All staff and Officers of IE	in-house Training program on Programming with PIC Microcontroller	IE, AERE	20 - 24 Oct. 2019	IE, AERE

7. Participation in Training

- Farhana Hafiz, CE has been participated in training course on E- Nathi Training Program, 13 - 16 Oct. 2019, organized by Institute of Computer Science, AERE
- Md. Mahbub Alam, SO, has been participated an In-house Training Program on Programming with PIC Microcontroller, 20-24 Oct. 2019, organized by Institute of Electronics, AERE
- Farhana Hafiz, CE and Md. Mahbub Alam, SO have been participated in training course on Environ. Radioactivity Monitoring, Radiation Measuring Instrument, 12 - 16 Jan. 2020, organized by Institute of Electronics, AERE

Nuclear Electronics Division, IE

Program(s)

- Design, development and fabrication of nuclear instruments for laboratory use
- Refurbishment of nuclear instruments
- Repair, maintenance and installation of nuclear and non-nuclear equipment
- Academic program: Supervise/Guide thesis work
- Human resource development and training program.

Activities

1. Research and Development (R&D) Activities

1.1 Design, development and fabrication of the area radiation monitor

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

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

It is a customized instrument for Insect Biotechnology Division, IFRB which is control the humidity of laboratory. OneUltrasonic Humidity Controllerhas been designed and supplied to IBD, IFRB. The development work of Humidity Controlleris 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.

2. Production of Electronic Gazettes

One Ultrasonic Humidity Controller,ModelNo.-032001 has been fabricated.

3. Lecture Delivered

- Scientists and Engineers of this division have delivered lectures in the Industrial Attachment Training Program from 02 Feb. to 15 Mar. 2020held at Institute of Electronics, AERE, Savar, Dhaka for the students of different Polytechnic Institute of Bangladesh.
- Scientists and Engineers of this division supervised two B.Sc. students of Nuclear Engineering Dept. of Dhaka University from 10 Dec.- 30 Dec., 2019 in cooperation with General Electronics Division.

4. Other

Fahmida Akter, P E, working as a Project Director of ADP Project "Improvement and modernization of the laboratory facilities of Institute of Electronics".

Production Division, IE

Activities

1. Production works

In order to meet the requirement of different institute of BAEC and organization of the country, the following electronic instruments have been produced.

Name of the equipment	Specification	Quantity	Made by
Production of drop-out-relay	Upper cut-off voltage: 250 V, Lower cut-off voltage: 180 V, Time delay: 3 min (Adjustable), Input voltage: 220 V AC (50Hz), Output (safe range): 180-250 V, Weight: 1.8 Kg (Approx)	05	M. I. Uddin

2. Repair and Maintenance works

Name of the equipment	Quantity
Drop-out relay	02
A. C. voltage stabilizer	01
pH Meter	01

3. Lecture Delivered

- Md. Iftakher Uddin, SEO delivered lectures in the Industrial Attachment Training Program from 02 Feb. to 15 Mar. 2020 held in Institute of Electronics for the students of different Polytechnic Institute of Bangladesh.

4. Training Arranged

Industrial Attachment Training Program has been arranged by Md. Iftakher Uddin, SEO from 02 Feb. to 15 Mar. 2020 held in Institute of Electronics for the students of different Polytechnic Institute of Bangladesh

5. Service Rendered and Revinue Income

Name of the services	Income
Designed instrument & system	88688/-
Import substitution (Value 40000/-)	free service
Instrument repaired (value 1805000/-)	Free service

Repair and Maintenance Division, IE

Objective/Introduction

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 Work(s)

About Fifteen (15) instruments are repaired, maintained and installed. The main Instruments are:

Name & Description of the Instruments	Intender
HP Color Laser jet Printer, Model: CP1515x, Serial No: CNAJ88009F, Manufacturer: HP, Country of Origin: USA	VLSI, IE
Printer LaserJet, Model: LBP-3300, Serial No LGHA328290, Manufacturer: Cannon, Country of Origin: China	ITBBR, AERE
Printer Laser jet, Model: P1102, Serial No: VNC3949817, Manufacturer: HP, Country of Origin: China	IE, AERE
Printer Laser jet, Model: P1102, Serial No: VNC4H44810, Manufacturer: HP, Country of Origin: Vietnam	IFRB, AERE
Water Distilation, Model:A8000, Serial No: 8S01743, Manufacturer: Bibby Sterilir Ltd, Country of Origin: England	AERD, IFRB
Printer (Leaser), Model: LBP- 3300, Serial No: LQNA589815, Manufacturer: Canon, Country of Origin: China	INST, AERE
Geophysical Logging System, Serial No: SN0937, Manufacturer: Advanced Logic Technology, Country of Origin: UK	INM, AERE
Printer (Leaser), Model: ML- 1911, Serial No: Z4BNBKEZA00252L, Manufacturer: Samsung, Country of Origin: China	CEF, AERE

Name & Description of the Instruments	Intender
Plena mixer Amplifier, Model: Plena Mixer, Manufacturer: Philips, Country of Origin: UK	IFRB, AERE
pH Meter, Model: ML- ixoLabpH720, Serial No:11080345, Manufacturer: WTW82362wilkeim, Country of Origin: Germany	INST, AERE
Computer Monitor, Model: S19A180N, Serial No:ZTRRHMBC501975p, Manufacturer: Samsung, Country of Origin: Malaysia	ITBBR, AERE
Online UPS, Model: O/L3KVA4kw Ltd, Serial No: 01-08-16/274116, Manufacturer: L- TECH BD, Country of Origin: Bangladesh	ICS, AERE
Canon Laser Printer, Model: LBP-3300, Serial No: LQHA535363, Manufacturer: Cannon, Country of Origin: China	ICS, AERE
HP Desktop Computer, Model: XL508AV, Serial No: CZC128516H, Manufacturer: HP, Country of Origin: China	IE, AERE
Desktop Computer, Model: Deluxe, Serial No: GAM110M-DS2V, Manufacturer: Gigabyte, Country of Origin: China	IE, AERE

2. Lecture Delivered

The scientists/Engineers of this division delivered lectures in the Industrial Attachment Training Programfrom 02 Feb. to 15 Mar. 2020held in Institute of Electronics for the students of different Polytechnic Institute of Bangladesh.

Robotics Instrumentation and Control Division, IE

Objective

To develop Robotics and Remote handling tools for different laboratories of BAEC

Activities

1. Research, Design and Development Work(s)

1.1 Robotics Instrumentation

Development of Robotics and Remote handling tools

1.2 Design and development of an air conditioner change over system

A programmable air conditioner change over system has been designed and manufactured. It can control the temperature of a room /laboratory. One air conditioner change over system has been supplied to IFRB, AERE, Savar and it is working satisfactorily.

2. Lecture Delivered

- The scientists/Engineers of this division delivered lectures in the Industrial Attachment Training Program from 02 Feb. to 15 Mar. 2020 held in Institute of Electronics for the students of different Polytechnic Institute of Bangladesh.

Solar Cell Febrication and Research Division, IE

Objective

- To develop a good research team to conduct research in the field of renewable energy
- To adopt the solar cell fabrication technology
- To train and develop skilled manpower in the field of renewable energy
- To fabricate high efficiency single crystalline silicon solar cell
- To provide environment for conduction research in the field of solar cell fabrication technology
- To test solar cell that are imported, as a standard testing laboratory for solar cell and solar panel
- To provide research facilities to the university's student on renewable energy
- To initiate research collaboration with home and foreign universities
- To help the government to achieve the millennium Development goal in the field of renewable energy.

Very Large Scale Integration Technology Division, IE

Objective

Very Large Scale Integration (VLSI) Technology Division has been established in the Institute of Electronics, AERE in 2012 to promote cutting-edge semiconductor research. This laboratory comprises two clean-rooms (white room of 10,000 grade and yellow room of 1,000 grade) along with several sophisticated fabrication and characterization instruments, enabling scientists to design, fabricate and characterize semiconductor material and devices. VLSI Laboratory opens the 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 MoO_3 nanoparticle and thin films.

2. Manpower Development/Training Program(s)

Name of the participant	Title of the event	Organizer	Date	Place
P. Sarker	In-house Training Program on Programming with PIC Microcontroller	IE, AERE	20 - 24 Oct. 2019	IE, AERE
All Scientists of this division	Training on Environ. Radioactivity Monitoring Radiation Measuring Instrument	IE, AERE	12 - 16 Jan. 2020	IE, AERE
	PPR-2008 and Public Procurement Management	TI, AERE	20 - 31 Oct. 2019	TI, AERE

INSTITUTE OF COMPUTER SCIENCE (ICS), AERE

Nuclear Cyber Security Division, ICS

Objective/Introduction

The main activities of Nuclear Cyber Security Division (NCSD) are to conduct basic & applied research on Nuclear Cyber Security, Cyber Design Basis Threat, Cyber Awareness Building, Cyber Security and Nuclear Safety Integration, Continuous Cyber Data Analysis, Computer/Information/Network Security, e-Learning Management System, Data Acquisition, Data Storage and Data Manipulation of different system of Data Center in BAEC and e-Nothi System implementation at BAEC. NCSD also provides training in the field of Cyber Security Awareness Building, e-Nothi implementation at BAEC and Human Resources Development of ICT sector at BAEC. NCSD publishes several articles in the peer reviewed journal, conference proceedings and participates in the relevant international/national seminars and workshops. NCSD division also provides IT enabled services to BAEC such as BAEC domain based official email services, Management Information System, e-Nothi services, Software and Web Application development, Security up gradation of inter-network infrastructure of BAEC through Hardware Firewall implementation. 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 online e-Learning management portal with moodle based software of human recourses development purpose and ensuring nuclear cyber security awareness to the public. The NCSD provides administration services of e-Nothi system at BAEC and its regional offices.

Activities

1. Research and Development Work(s)

1.1 Research on Nuclear Cyber Security and computer network security at BAEC

Md. Shamimul Islam, Dr. Md. Dulal Hossain

Internal network like LAN and Wi-Fi system has been designed and developed at BAEC HQ, AERE and AECD. This LAN and Wi-Fi connection are now being used as a purpose for the internet connection to

computer, Laptops and Digital Control Systems**.** About 450 (Four hundred and fifty) LAN connection and a total of 54 (fifty four) wireless routers has been set up at AERE. The total network connections are being provided through ICS server room. Though the location of connections are remotely established, so media converter and different switches are being used for data traffic. Dynamic Host Configuration Protocol (DHCP) connection is being provided through Wi-Fi Router. Static IP are being provided to the LAN. The specified password and user name selected by the authority are being used on these routers. A total number of 3 private networks have been created to produce IP for the users. To maintain this huge network system and ensuring security a firewall system in server room has been designed which are now implementing. Our target is to provide High speed internet services and ensuring its security at Atomic Energy Research Establishment (AERE) Campus as well.

1.2 Research on Nuclear Knowledge Management System

Md. Shamimul Islam, Dr. Md. Dulal Hossain

Bangladesh Atomic Energy commission (BAEC) is a multidisciplinary research organization where various researches are going on in different fields. For identifying, acquiring, transforming, developing, disseminating, using, sharing and preserving knowledge, relevant to achieving specified nuclear knowledge and by a Computer based automation will be helpful for the development for the nuclear knowledge for the BAEC.

Fig: Nuclear Knowledge Management

Documentation in this area and Research are in progress.

1.3 Research, Implementation and Administration of E-Nothi System at BAEC HQ and its regional offices

Md. Shamimul Islam, Dr. Md. Dulal Hossain, Dr. Md. Shakil Ahmed

BAEC and its regional offices surrounds with many official activities. BAEC has many activities that's has to handle with official documents to accomplish research and managerial task. An E-Nothi system is an online software system developed by A2I under ICT Division, Bangladesh. BAEC configured this software for organizing, administrating and storing different kinds of manual Nothi documents. The admin of E-Nothi system who is from the NCSD division at BAEC plays a vital role for implementing the system. The admin can easily join an employee to the system, can make resign the employee by taken order from higher authority, Nothi headings edit, any mistaken correction etc.

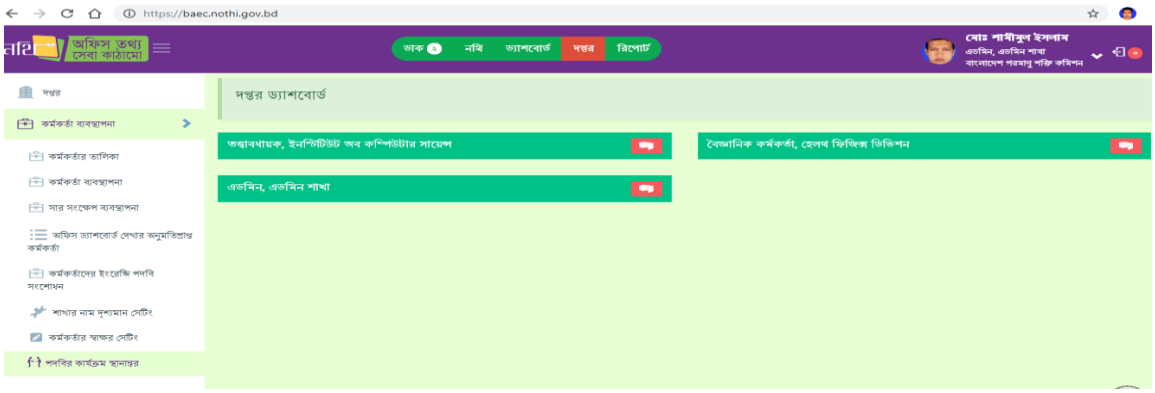


Fig. Administration Panel of BAEC E-Nothi System

2. Manpower Development and Training Program

Title of the event	Date	Organizer	No. of participant
E-nothi implementation related training	16 - 18 Apr. 2019	BAEC, HQ	20
	13 - 16 Oct. 2019	ICS, AERE	25

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

Name of the participant	Title of the event	Organizer	Date	Place
M. S. Islam	Workshop on Leveraging Technologies for Sustainable Development	National Academy of Planning and Development	01 - 05 Dec. 2019	NAPD, Dhaka

4. Service Rendered

Name of Service(s)	No. of service
Domain based official email services	450
MIS services	2200
E-Nothi services	500
Total	3150

Computer System and Network Division, ICS

Objective/Introduction

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 prepared 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 Up-grade Design and Deployment of Local Area Network of 100Mbps bandwidth implement of AECD, Dhaka

M. A. Shameem, M. O. Goni and J. Ferdose

ISP provides high speed internet communication. To fulfill the current requirements of AECD 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. We consider actual component selection, placement, installation practices, testing, troubleshooting and network equipment installation and startup. Finally, we consider documentation, maintenance and planning for restoration in event of an outage. Existing local area network (LAN) consists of computer network that interconnects computers situated in different buildings at AECD using network media. Inside LAN, our employees are offered a computer network design applying metallic structured cabling CAT-6. This cabling enables data transfer up to 100Mbps. The network backbone is then customized using optical links. We perform dimensioning of active elements, such as switches, Cisco

routers and MikroTik Router to ensure their margin was sufficient to meet our data throughput 500Mbps rate requirements. We provide 100Mbps internet bandwidth from BDCOM Online Ltd. for high speed broadband internet services. Planning the route of optical fiber from BDCOM Online Ltd. to AECD to determine exactly where the cable plant and hardware will be located having decided to use fiber optics and chosen equipment appropriate for the application. As every installation is unique, the actual placement of the cable plant is determined by the physical locations from BDCOM Online Ltd. to AECD Campus along the route. The route distance is around 400 meters and we deploy the cable in the underground/overhead. Furthermore, as always premises and outside plant installations are different so we consider them separately. Finally planning for the deployment is a critical phase of any work as it involves coordinating activates of many people. We develop a checklist based on the design path for smooth installation.

1.2 LAN Design and Network Devices Cisco Router, MikroTik Router, Manageable Switch Installation at Atomic Energy Centre, Dhaka

M. A. Shameem, M. O. Goni and J. Ferdose

The internet is a structured, organized system. Each network requires a structured planning and designing before deployment it that requires internet access, Internet connectivity factors should be included into the plan, Includes a practical design of network internet connectivity backbone. Procedures of selecting equipments are added and planning designs their networks. The LAN of AECD interconnects more than 160 Computers/ Wi-Fi user using various network media. The previous LAN was not properly working; as a result the internet service was interrupted. Hence, the previous LAN was redesigned and up gradated using network devices Cisco Router, MikroTik Router, Manageable Switch installation currently, internet service is smoothly running at AECD. LAN Networking at AECD smoothly installed. We are expected to have a concept to any of the common Linux operating systems. Every network requires a regular maintenance such as storage maintenance, remote resource access, user management, log management and some other management. Monitoring is a regular task for all network system. It is mandatory when the system is dedicated to public service to make a user friendly and dependable monitoring system. As a result of this LAN network, Atomic Energy Certre, Dhaka (AECD) is getting a high speed internet service.

2. 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, 55 computers have been repaired and upgraded during this period. A list of these activities for the period of July-2019 to June-2020 is given below:

Name of the Institute	No. of PC
Institute of Nuclear Science and Technology, AERE	03
Institute of Food and Radiation Biology, AERE	05
Institute of Computer Science, AERE	10
Central Engineering Facility, AERE	10
Institute of Nuclear Mineral, AERE	08
Central Administrative Division, AERE	07
Central Finance & Accounts Division, AERE	04
Scientific Information Unit, AERE	03
Institute of Radiation & Polymer Technology, AERE	03
Training Institute, AERE	02

3. Preparation of ID card

The Official ID card for each employee working in BAEC is prepared by Computer System and Networking Division, Institute of Computer Science. In July-2019 to June-2020 more than 268 ID cards have been prepared by Computer System and Networking Division from different Institutes/Divisions in BAEC.

Name of the Institute	No. of Card
Institute of Nuclear Science and Technology, AERE	26
Institute of Food and Radiation Biology, AERE	19
Institute of Electronics, AERE	10
Institute of Computer Science, AERE	06
Central Engineering Facility, AERE	11
Institute of Nuclear Mineral, AERE	05
Central Administrative Division, AERE	07
Central Finance & Accounts Division, AERE	06
Daily Basis Employe, AERE	15
Student, AERE School & College	01
Energy Institute, AERE	01
Institute of Tissue Banking and Biomaterial Research, AERE	08
Center for Research Reactor, AERE	12
Scientific Information Unit, AERE	01
Institute of Radiation & Polymer Technology, AERE	02
National Institute of Nuclear Medicine & Allied Sciences, Dhaka	31
Atomic Energy Centre, Dhaka	38
BAEC Head Quarter, Dhaka	35
Institute of Nuclear Medicine & Applied Science, Rajshahi	25
AERE, Clinic	02
Training Institute, AERE	03
Nuclear Medical Physics Institute, AERE	04

4. Assemble, Installation, New Connection, Fiber Splicing, Troubleshooting, Repair and Maintenance of Network devices

A number of Assemble, New connection, Splicing, Troubleshooting, Repair and Maintenance of Network devices/Internet Connection for ICS as well as other Institute of BAEC. Beside this, 755 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 these activities for the period of July- 2019 to June-2020 is given below:

Name of the Institute	No. of Card
Institute of Nuclear Science and Technology, AERE	85
Institute of Food and Radiation Biology, AERE	144
Institute of Electronics, AERE	26
Institute of Computer Science, AERE	12
Central Engineering Facility, AERE	17
Institute of Nuclear Mineral, AERE	16
Central Administrative Division, AERE	46
Atomic Energy Center, Dhaka	120

Name of the Institute	No. of Card
BAEC Head Quarter, Dhaka	133
Energy Institute, AERE	23
Tissue Banking and Biomaterial Research Unit, AERE	17
Center for Research Reactor, AERE	02
Scientific Information Unit, AERE	11
Training Institute, AERE	28
Institute of Radiation & Polymer Technology, AERE	40
Hostel Block, DG Banglo & Quarter, AERE	35

5. Manpower Development and Training Program

Title of the event	Date	Organizer	No. of participant
Industrial attachment training program based on computer science	4 Mar. - 31 May 2020	ICS, AERE	38

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

Name of the participant	Title of the event	Organizer	Date	Place
Engr. M. A. Shameem	Training program on PPR 2008 and Public Procurement Management Course for the officer of Bangladesh Atomic Energy Commission	BIM, Dhaka	15 - 26 Sept. 2019	BIM, Dhaka

Software Engineering Division, ICS

Objective/Introduction

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 Real-time natural and artificial radioactivity data acquisition and computational system

M. M. Alam, N. K. Datta, M. A. Haydar, M. S. Ahmed and M. D. Hossain

Radioactive contamination into the environment particularly atmosphere is one of the major concern issue to the world nuclear research communities. Both natural and artificial radioactivity may contribute to contaminate the atmosphere. Natural radioactivity into the atmosphere is due to the spontaneous emission of radiations from unstable nuclei which are available in the environment as a default element of the earth. It is an integral part of our environment. On the other hand, artificial radioactivity may arise from the nuclear fuel cycle activities of the nuclear and radiological facilities such as nuclear power plant, research reactor and nuclear waste management, etc. Both natural and artificial radioactivity is distributed widely throughout the environment in which we live. The radioactivity contamination are strictly controlled to protect the environment and to ensure that the people who may be exposed. Because people are considered to be the

ultimate sufferer through radiation. The presence of the radioactivity in the atmosphere has a direct impact on peoples' respiratory system, while indirect contamination occurs by consumption through the food chain. The ill-effects of radioactive pollution are numerous. Radiation can cause cancers, abnormal births, skin diseases and mutations in man. Chronic exposure to radiations leads to leukemia in an individual and even affects an unborn child in the womb.

In Bangladesh several nuclear and radiological facilities at different places have been operated for the development, use and expansion of atomic energy. In addition, Rooppur Nuclear Power Plant (RNPP) is being constructed at Rooppur, Pabna which would be the country's first nuclear power plant. The first of two units of the RNPP are expected to go into operation in 2023. These huge numbers of radioactive facilities in Bangladesh may release radioactivity into the environment during their normal operation or radiological accidents that should be firmly monitor to prevent the occurrence of any radiological hazards/disasters.

To address the above mentioned issues, we have proposed this project "Real-time natural and artificial radioactivity data acquisition and computational system around the environment of the radiological facilities". Our proposed real-time natural and artificial radioactivity data acquisition and computational system will automatically acquire radioactivity data from the atmosphere around the radiological facilities in real-time and store these acquired data into a data base. An automated computational system will compute the acquired data to detect as well as to produce various reports of radioactive also in real time. Additionally, this system will have an emergency safety notification system which will generate safety alarm if any critical condition or radiological hazards/disasters occurred.

Though there are several systems that are currently being operated at the radiological facilities to monitor the Environ. radiation but most of the systems are manual. In the manual system, radiation surveyors acquire the atmosphere radioactive by a survey meter for a particular period of time, then copy/store these data to a computer and finally analysis the acquired data manually to detect the radioactivity of the atmosphere. In this process, it is very difficult to identify the occurrence of any critical condition in time that may lead radiological hazards as well as radiological disasters. As a result, people and radiation-workers will be affected by the radiation. But our proposed system will be an automated system that will identify the occurrence of any critical condition of the radiological facilities by detecting the Environ. in real-time. As a result, it will identify any critical situation as soon as it occurred and through the emergency safety notification system radiation-workers will be informed about the critical condition. In addition, this system will produce various reports of the Environ. radioactivity around the nuclear and radiation facilities that will lead a safe and secured working environment.

1.2 Real-time GPS-GSM based tracking system to conquer the inadvertent trafficking of radioactive materials

M. M. Alam, N. K. Datta and M. S. Ahmed

With the increase use of radioactive materials in industry, medicine, agriculture, research and training, the transport of such materials from manufacturers to end users as well as to the safe disposal have become more frequent and large in volume. Since radioactive materials transportations take place in public domain and involve intermodal transfer, inadvertent trafficking such as loss, theft, sabotage, malicious acts or unauthorized possession of the radioactive materials may occur. In such cases, the authorities including government, regulators, operators, carriers and users would be expected to develop the capability to take actions leading to recovery the control over radioactive materials to mitigate possible consequences and to reduce further risks. A real-time GPS-GSM (Global Positioning System - Global System for Mobile) based tracking system with google map based monitoring can be one of the best candidates to conquer the inadvertent trafficking of radioactive materials. The real-time GPS-GSM based tracking system with google map based monitoring can be the key equipment to observe the real-time location as well as right route during the transport of radioactive materials. By observing the transport route of the radioactive materials on google map, the last location and the circumstances associated with the losses, potential losses of control, or theft can be notified. The initial notification needs to be prompt in order to ensure an appropriate response.

The radioactive material by all means must be transported according the States' and IAEA's transport safety regulations depending on modes: on land, water or in the air. With the proviso of nationwide land and water transportation, a real-time GPS-GSM based location tracking system can be included with the packages containing radioactive material to monitor the real-time location all over the destination route on google map. This location reacting system which can be treated as safety infrastructure instrument is complemented by other measures to recover stolen material and mitigate possible consequences and thus conquer the inadvertent trafficking of radioactive material.

GPS-GSM is one of the user friendly and easily installable technologies that has been using world-wide to track the vehicles as well as delivery services to keep regular monitor on them. GPS is a satellite navigation system that signals can be used to calculate the three dimensional position of a user located anywhere on the earth surface and GSM is worldwide standard for cellular communication. In this study, a real-time GPS-GSM based tracking system can be built up on a microcontroller board with GPS receiver and GSM modem. The GPS receiver computes the real-time position of the radioactive material and microcontroller sends that location to the GSM modem. Then the GSM modem sends the location of the radioactive material to the Google map links.

1.3 Testing and Debugging of Online Management Information System (MIS) of BAEC

N. K. Datta, M. M. Alam and M. S. Ahmed

An online management information system (MIS) is an internet based system that capable to store all kind of official information organized and programmed in such a way that it produces regular reports on operations for every level of management of BAEC. Top management can monitor the organization as a whole; thus it measures progress against goals. Some of the data are collected automatically from computer-linked information's; others are keyed inputted in at periodic intervals.

Management Information System (MIS) play an important role in organizations and management operations. Management information system, or MIS for short, is a kind of information system. It is a key factor to facilitate and attain efficient decision-making in an organization. Its performance relates to many other information systems, for instance, decision support system, strategic information system, etc. Methods of testing statistical hypotheses concerning the performance of MIS are absolutely essential to support management activities and decision-making.

A 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.

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:

- Define the problem and collect data for the problem
- Identify and evaluate feasible solutions
- 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 Ltd. 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.

1.4 Contents Management, Up-gradation and Uploading of the official web portal of BAEC

N. K. Datta, M. M. Alam and M. S. Ahmed

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 and M. S. Ahmed

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 and M. S. Ahmed

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. Seminar/Symposium/Conference/Workshop/Meeting Attended

Name of the participant	Title of the event	Organizer	Date	Place
Dr. M. M. Alam	Environ. Radioactivity Monitoring-2020	BAEC	12-16 Jan. 2020	TI, AERE
	International Conference on Earth and Environ. Sciences & Technology for Sustainable Development ICEEST-2020	Faculty of Earth and Environ. Science, DU	25-27 Jan. 2020	Inter Continental Hotel, Dhaka

3. Service Renderd

Name of the Services	Nature of service	No. of services
Management and Maintenance Official Web-portal of BAEC	ICT Based Expert Servicers	As per required
Contents Uploading at the Official Web-portal	ICT Based Expert Servicers	370 (apprx.)
Management and Maintenance Directory of Personnel of BAEC	ICT Based Expert Servicers	100 (apprx.)
Management and Maintenance Foreign Visit Records Web-based software of BAEC	ICT Based Expert Servicers	50 (apprx.)

INSTITUTE OF ENERGY SCIENCE (IES), AERE

Objective/Introduction

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, the newly established institute in the Atomic Energy Research Establishment has been started functioning in 3 Apr. 2008 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)

- Engineering analysis of nuclear reactors, with particular emphasis on reactor physics, design and safety
- Development of methods, tools and techniques to investigate fission product inventory and to carry out decommissioning studies of nuclear reactors
- Atmospheric dispersion modeling and radiological safety analysis of nuclear reactors
- Setting up a heat transfer facility to study thermal hydraulics and safety parameters of LWRs
- Design study of innovative next generation nuclear reactors
- Nuclear fuel performance, core management and fuel cycle analysis
- Probabilistic safety assessment (PSA) of nuclear.

2. Collaboration Work(s)

- S &T Project: Special allocation project for Ministry of Science and Technology entilted Radiological Consequence Analysis due to Release of Radio xenon from TRIGA Research ReactorÓ is under completion
- IAEA TC Project: “Strengthening Capacity in the Design and Development of Spent Fuel Storage and the Reactor Safety Testing Laboratory (BGD/1013)” is on-going.

INSTITUTE OF RADIATION AND POLYMER TECHNOLOGY (IRPT), AERE

Objective/Introduction

Institute of Radiation and Polymer Technology (IRPT) is devoted to innovative research and development work by the direct utilization of radiation processing technologies. The foundation of the Institute was built up in 2010 and has been capable, through creative research and technological accomplishments in polymer science and industrial use of gamma radiation sterilization process to add to the national development goal for obtaining self-sufficient economy. The Institute has the 350 kCi Co-60 gamma source which is the largest capacity source in Bangladesh. The main objectives of the institute are:

- Application of radiation processing technologies for the socio-economic development of the country.
- Providing commercial gamma irradiation services for quality improvement of food items and sterilization of medical products, pharmaceutical raw and packaging materials etc.
- To provide irradiation service to research organizations for R & D purpose.

- To expand cooperation with other scientific organizations, universities, private and public sectors through mutual exchange of educational programs, training, technical cooperation and expert services.
- To develop human resources in the field of nuclear science and technology.
- Transferring the technology to the entrepreneurs for industrial applications.

Activities

1. 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. Physico-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 hydrogel were prepared for biomedical application and heavy metal removal

1.3 Use of radiation, chemical and microbiological tools for water treatment for different uses

Physico-chemical and microbiological quality assessment of surface water of Turag river, Buriganga river and different aquaculture pond in Savar, Dhaka were 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.

2. Repair & Maintenance and Renovation Works

Mechanical problem of IRPT Co-60 Gamma plant was resolved and plant started working properly.

Demineralize water treatment plant was installed for IRPT Gamma source. The capacity of water treatment plant is 1000L/hr.

A process controller was installed for Twin Screw Extruder Machine of IRPT.

Repair and maintenance work were done for Heat Press Molding Machine of Composite Lab of IRPT. Hydraulic O ring, gasket, pressure bucket, hydraulic oil, hydraulic jack was replaced.

3. Seminar Arranged

Title of the event and speaker	Date	Place	No. of participant
Application of Composite Materials	24 Feb. 2020	IRPT, AERE	19
Research of Pool Water of the Plant IRPT	17 Feb. 2020	IRPT, AERE	20
Research on Gamma Radiation at IRPT	10 Feb. 2020	IRPT, AERE	15
Characterization of Composite Materials	26 Jan. 2020	IRPT, AERE	18
Personal Monitoring for Radiation	20 Jan. 2020	IRPT, AERE	19
Shielding Materials for Gamma Radiation	13 Jan. 2020	IRPT, AERE	20
Category of Radioactive Sources	18 Dec. 2019	IRPT, AERE	19

Title of the event and speaker	Date	Place	No. of participant
Fabrication of Composite Materials	11 Dec. 2019	IRPT, AERE	20
Recruitment of IRPT	25 Nov. 2019	IRPT, AERE	20
Media Handling During Nuclear Accidents	19 Nov. 2019	IRPT, AERE	18
Nuclear Grade Water	12 Nov. 2019	IRPT, AERE	19
Radiological Accidents	23 Oct. 2019	IRPT, AERE	20
Environment Radioactive Monitoring	16 Oct. 2019	IRPT, AERE	19
Characterization of Polymer	09 Oct. 2019	IRPT, AERE	20
Radioactive Source Protection	24 Sept. 2019	IRPT, AERE	20
Security System of Radiation Plant	17 Sept. 2019	IRPT, AERE	20
Radioactive Materials	09 Sept. 2109	IRPT, AERE	17
Radiation Protection	26 Aug. 2019	IRPT, AERE	20
Plant Growth Promoter	19 Aug. 2019	IRPT, AERE	18
Innovation	05 Aug. 2019	IRPT, AERE	19

4. Seminar/Symposium/Conference/Meeting Attended

Name of participant	Title of the event	Organizer	Date	Place
Dr. R. A. Khan	Visit to Gamma Service Recycling GmbH	Gamma Service Recycling GmbH	24 Feb. - 3 Mar. 2020	Germany
	Symposium	Zwick/Roell	13 - 20 Oct. 2019	Germany

5. Stakeholder Seminar/Meeting Arranged

Arranged several stakeholder meetings with different company e.g. Pran Agro Ltd., Square Food and Beverage Ltd. for promoting irradiation services to these stakeholders between Jul. 2019 to Jun. 2020 at IRPT.

6. Service Rendered and Revenue Income

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, fam ily planning kits, eye ointment, mannitol, PEG-600, bacitracin Zn etc.

No. of service given to the organization	Nature of sample	Quantity of sample	Income
2 companies (21 consignment)	Food irradiation	110.979 Ton	3774567/-
2 companies (5 consignment)	Medical products	5620 pieces + 458 cft	261300/-
2 companies (37 consignment)	Pet Food	26.904 Ton	1117175/-
Total			5152972/-

INSTITUTE OF NUCLEAR MINERALS (INM), AERE

Introduction

INM is mainly engaged in nuclear mineral exploration program in the potential area of Bangladesh. This institute is also involved in coal seam delineation as well as groundwater aquifer studies in different parts of Bangladesh. In addition, this institute provided geophysical borehole logging services as per demands of different organizations/companies.

Activities

1. Research and Development Work(s)

1.1 Heavy metal concentration and pollution assessment of the beach sediments in upper foreshore area of the Bay of Bengal

F. Deeba, M. Z. Kabir, M. G. Rasul, R. K. Majumder, M. I. Khalil, N. T. Dina and M. S. Islam

Assessment of heavy metals in coastal/beach sediments from upper foreshore (Shamlapur-Teknaf) coastal area of the Bay of Bengal was carried out using Energy Dispersive X-Ray Fluorescence (EDXRF) technique with the computation of different pollution indices. The pollution indices such as Contamination Factor (CF), Pollution Load Index (PLI), Contamination degree (C_d), Modified degree of Contamination (mCd), Potential Contamination Index (Cp) and Potential Ecologic Risk Index (RI) were applied for the evaluation of metal enrichment and contamination status. In the study area the mean order of metal concentration is Ca>Fe>Al>Ti>k>Mg>V>Sn>Cr>Zn>Rb>Cu>Sr>Rb>As>Co>U>Hg. The Contamination factor (CF), Pollution Load Index (PLI), Contamination degree (C_d), Modified degree of Contamination (mCd), Potential Contamination Index (Cp) value of the present study shows that the sediments are moderate to considerably contaminated with Fe, Cu, Zn, Ca, Ti and Cr and considerably to highly contaminated with V and very highly contaminated with Sn. The Potential Ecologic Risk Index (RI) of the studied elements indicates that the area represents low ecologic risk of local environment.

1.2 Borehole geophysical logging for groundwater aquifer delineation and water quality assessment at Teknaf, Cox' Bazar, Bangladesh

M. I. Khalil, M. G. Rasul, R. K. Majumder, M. Z. Kabir, F. Deeba, M. S. Islam, N. T. Dina and S. C. Das

Geophysical loggings using gamma, SP and resistance tools were performed in a boreholes located at Teknaf, Cox's Bazar to determine the subsurface layer properties and to delineate the potential aquifer zones from the sub surface layers. From Gamma, Self Potential (SP) and Single Point Resistance (SPR) logs groundwater aquifers were delineated and water quality was assessed. 50-120 cps gamma values, positive SP deflection and 85-100 Ω resistance values delineate tertiary aquifers in the area. The upper aquifer lies at 450-510 feet depths while lower aquifer lies at 590-650 feet depth. Positive deflection of SP curve and resistance values represent that both upper and lower aquifers contain fresh water.

1.3 Natural radioactivity in soil and rock samples from Dibir Haor-Yam Bil and adjacent areas of Jaintapur, Sylhet, Bangladesh

N. T. Dina, S. C. Das, M. I. Khalil, M. Z. Kabir, F. Deeba, M. S. Islam, R. K. Majumder, M. G. Rasul, M. A. Haydar, M. I. Ali* and D. Paul*

Naturally occurring radionuclides ^{226}Ra (^{238}U), ^{232}Th and ^{40}K have been measured using HPGe gamma-ray spectroscopy in soil and rock samples from Dibir Haor, Horofkata, Kendri Bil, Yam Bil and adjacent areas of Jaintapur, Sylhet. The average activity concentrations of ^{226}Ra (^{238}U), ^{232}Th and ^{40}K for soil and rock samples in this current study are 45±3, 60±5 and 815±542 Bq.kg^{-1} respectively. The average activity concentration of radionuclides in soil and rock samples exceeds the world average. The radiological hazard indices of the samples were also calculated. The mean values obtained from soil and rock samples are 194 Bq kg^{-1}, 91 nGy h^{-1}, 110 μSv y^{-1} and 0.52 for Radium Equivalent Activity (Ra_{eq}), Absorbed Dose Rates (D), Annual Effective Dose Equivalent (AEDE) and External Hazard Index (H_{ex}) respectively. The external hazard index, the radium equivalent activity exceeds the permissible limits whereas the annual gonadal dose equivalent associated with the investigated soils and rocks exceeds the limits.

*Health Physics and Radioactive Waste Management Unit, AERE

1.4 Analysis of radon concentration in groundwater from sandstone aquifer of Maddhapara hard rock mining area Dinajpur, Bangladesh

M. Z. Kabir, F. Deeba, S. C. Das, M. G. Rasul, R. K. Majumder, M. I. Khalil, M. S. Islam and N. T. Dina

Groundwater of deep sandstone aquifer system tends to contain elevated concentrations of naturally occurring radionuclides which has potential impact on the water quality. Uranium in the groundwater may occur in high concentrations in areas associated with ore deposits, weathered soils and rocks derived from granite and in some bedrock aquifers. The concentration of Uranium might have been originated from the zones of uranium minerals and leached to the groundwater by the rock water interaction the host rocks and thus during decay the radon formed also dissolves in the groundwater. In the present investigation, analysis of radon concentration in 20 water samples (Deep Tube Well water, Mine water, Basement seepage water) collected from different locations of Maddhapara Hard Rock Mining Area, Dinajpur, Bangladesh has been carried out by using Alpha Guard PQ2000 PRO (Saphymo, Germany) radon monitor. The average measured radon concentration in water samples is 51.14±5.4 (x 10^2 Bql^{-1}) in mine water, 25.02±2.0 (x 10^2 Bql^{-1}) in deep tube well water and 4.75±1.0 Bql^{-1} in basement seepage water.

1.5 Heavy metals pollution indices and multivariate statistical evaluation of groundwater quality of the coastal area of Bangladesh

F. Deeba, M. Z. Kabir, M. G. Rasul, R. K. Majumder, M. I. Khalil, N. T. Dina, S. C. Das and M. S. Islam

Investigation was carried out on groundwater quality from Cox's Bazar to Teknaf of the south eastern coastal area of Bangladesh. A total of 15 groundwater samples were collected from tube wells at different depth from 6.5-137m. Heavy metal evaluation index (HEI), Degree of contamination (C_d), Nemerow pollution index (NI) and Heavy metal pollution index (HPI) were employed to evaluate the status of the overall pollution level of ground water. Pearson correlation, Principal component analysis (PCA), Cluster analysis (CA) and Hierarchical cluster analysis (HCA) were applied to identify the pollution source and factors controlling groundwater quality. This study reveals that the C_d of the groundwater samples ranges 8.47-49.90 (mean 22.99). HPI value for the groundwater samples ranges 67.20-328.71 (mean 211.51). The heavy metal evaluation index (HEI) ranges from 17.47 to 58.90 (mean 31.99). The range of NI for the groundwater samples varies from 4.20 to 20.12 (mean 8.91). It is found that the study area exhibits the high degree of pollution and groundwater of the area is influenced by both natural and anthropogenic factors.

1.6. Nuclear borehole logging for gondwana coal seams at the northwestern part of Bangladesh

S. C. Das, N. T. Dina, M. I. Khalil*, M. Z. Kabir, F. Deeba, M. S. Islam, R. K. Majumder and M. G. Rasul

Nuclear borehole logging, a subset of geophysical technique, has widely been used in the delineation of geological resources like oil, gas, coal, uranium and minerals due to the deep penetration of neutron and gamma rays. This article aims to identify and characterize the Gondwana coal seams from Barapukuria Coal Basin and Phulbari Coal Basin at northwestern part of Bangladesh by means of gamma and gamma-gamma logging as these offers the most precise geophysical means of delineating coal seams and estimating their thickness. Gamma and gamma-gamma logging were carried out in the boreholes AEN-13, AEN-23, AEN-30, AEN-40 and AEN-42 at the Phulbari coal basin and CSE-19 at the Barapukuria coal basin. Coal seams were delineated from low gamma counts and high gamma-gamma counts of the nuclear logging. 33.98m thick coal seam was delineated at CSE-19 borehole while 13.59m thick upper seam and 16.42-26.9m thick main seam were delineated at AEN 13, 23, 30, 40 and 42 boreholes. Coal seams were found at 163 to 261.93m depth in Barapukuria Coal Basin and Phulbari Coal Basin. Gamma counts in coal seams increases at AEN-13, AEN-40 and AEN-42 due to increase of impurities (ash) in coal seam.

1.7 Estimation of radon concentration in soil and rocks of Jaintapur and its adjacent areas, Sylhet, Bangladesh

R. K. Majumder, M. I. Khalil, M. Z. Kabir, F. Deeba, N. T. Dina, S. C. Das, M. S. Islam and M. G. Rasul

Radon is a naturally occurring radioactive alpha particle emitting gas produced by radioactive decay of uranium and thorium. Radon monitoring technique has been used as a geological tool for uranium exploration

in Jaintapur and its adjacent areas of Sylhet district of Bangladesh. The current study represents, radon concentration measurements in the soil gas of Soil and rocks from different locations of Jaintapur and its adjoining areas of Sylhet, Bangladesh has been carried out by using Alpha Guard PQ2000 PRO (Saphymo, Germany) radon monitor. Radon concentrations were found in the range of 8 Bq/m^3 to 4360 Bq/m^3 with an average value of 851.41 Bq/m^3. The higher concentration of radon was found in Tipam sandstone formation in Kocharai and Banpara area. The lower concentration of radon was observed in alluvial soil deposits in Bokabil area.

2. Training program/Workshop/Seminar/Symposium/Conference Arranged

Name of the speaker	Title of the event	Date	Place	No. of participant
Dr. M. G. Rasul	R & D Activities of Institute of Nuclear Minerals	24 Nov. 2019	INM, AERE	20
Dr. R. K. Majumdar	Uranium Exploration Status in Bangladesh: Conceptual Feasibility Studies	26 Nov. 2019	INM, AERE	20
Dr. M. I. Khalil	Nuclear Geophysical Logging in Coal Exploration	12 Dec. 2019	INM, AERE	22
	Geophysical logging for ground water aquifer delineation and water quality assessment	22 Jan. 2020	INM, AERE	20
M. Z. Kabir	Radon detection in ground water sample	22 Dec. 2019	INM, AERE	22
F. Deeba	Separation and identification of heavy minerals.	12 Nov. 2019	INM, AERE	19
	Geochemical and radiological characterization of soil and sediments	05 Jan. 2020	INM, AERE	20
Engr. S. Islam	Preventive maintenance works of electronic instruments	14 Nov. 2019	INM, AERE	20
	Repair and maintenance works of electronic and nuclear electronic instruments	19 Jan. 2020	INM, AERE	20
S. C. Das	History, development, activities and future of INM	20 Nov. 2019	INM, AERE	20
	Petrologic, geochemical and petrogenetic study of crystalline basement rocks from Voktipur, Rangpur District, Bangladesh	29 Dec. 2019	INM, AERE	22
	Tectonothermal evolution of Eastern Ghats mobile belt	26 Jan. 2020	INM, AERE	19
Munsi Maksud Rana	Basic Office Management	8 Dec. 2019	INM, AERE	22

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

Name of the Participant	Title of the event	Organizer	Date	Place
Dr. M. G. Rasul	Project Review Meeting on Deploying Technology and Management of Sustainable Uranium Extraction Projects	IAEA	11-15 Nov. 2019	Nanchang, China
	IAEA Project Review Meeting	IAEA	2-6 Dec. 2019	Vienna, Austria

Name of the Participant	Title of the event	Organizer	Date	Place
Dr. R. K. Majumder	Project Review Meeting on Deploying Technology and Management of Sustainable Uranium Extraction Projects	IAEA	11-15 Nov. 2019	Nanchang, China
	Project Review Meeting on Conducting Comprehensive Management and Recovery of Radioactive and Associated Mineral Resources	IAEA	2-6 Dec. 2019	Vienna, Austria
Dr. M. I. Khalil	Inter-regional training course on Siting for Nuclear Power Plants	IAEA	22-26 Jul. 2019	Vienna, Austria
M. Z. Kabir	Training Course on Remediation and Treatment of Ground and Mine Water Affected by Uranium Mining	IAEA and WNUSUP	19-30 Aug. 2019	Straz, Czech Republic
Dr. M. G. Rasul, Dr. R. K. Majumder, Dr. M. I. Khalil, M. Z. Kabir, F. Deeba, N. T. Dina and S. C. Das	International Conference on Earth and Environ. Science &Technology for sustainable Development- 2020	Faculty of Earth and Environ. Science, DU	25-27 Jan. 2020	Inter Continental Dhaka
Dr. M. G. Rasul, Dr. R. K. Majumder, Dr. M. I. Khalil, M. Z. Kabir, F. Deeba, M. S. Islam, N. T. Dina and S. C. Das	International conference on Physics	Bangladesh Physical Society	5-7 Mar. 2020	AECD
M. S. Islam	Seminar on Skill Readiness for Achieving SDGs & Adopting IR 4.0	IDE, Dhaka	2-4 Feb. 2020	IDEB, Dhaka
N. T. Dina	Training Course on Radiation Protection for Radiation Workers and RCOs of BAEC, Medical Facilities & Industries-2019	TI, AERE	15-19 Sept. 2019	AERE
S. C. Das	BAEC-JAEA joint Follow-up Training Course (FTC)-2019 on Nuclear and Radiological Emergency Preparedness Course	TI, AERE	24 Nov.- 5 Dec. 2019	AERE
	BAEC-JAEA joint Follow-up Training Course (FTC)-2020 on Environ. Radio- activity Monitoring Course	TI, AERE	12-16 Jan. 2020	AERE

4. Collaboration Work/MoU

Under the special allocation of the Ministry of Science and Technology for the Financial Year 2019-2020 a project entitled "Measurement of Radon Concentrations in Soil, Sediment and Groundwater for Environ. Radiological Assessment at the West Coastal Areas of Bangladesh" has successfully been completed.

5. Service Rendered and Revenue Income

Name of service provided	Nature of service	Quantity	Income
Borehole geophysical logging service for groundwater quality assessment and aquifer studies in Teknaf area, Cox's Bazar	Spontaneous Potential, Electric, Resistivity, Gamma	1	35000/-
Total		1	35000/-

NUCLEAR MEDICAL PHYSICS INSTITUTE (NMPI), AERE

Introduction

Institute of Nuclear Medical Physics (INMP) is the pioneer institute which introduced the radiotherapy treatment by LINAC to the cancer patients under Bangladesh Atomic Energy Commission (BAEC) which was started in 2018 and is located at Ganakbari, Savar, Dhaka. In Bangladesh, cancer is the leading cause of mortality due to insufficient of treatment service and also highly expensive. This institute provides the diagnostic service by using PET-CT, the radiotherapy treatment service by using LINAC and also follow up regularly for the cancer patients. INMP consists of a team of professionals oncologists, dynamic medical physicists, information professionals and well-trained technologists who are promised to ensure the better treatment with the minimum cost all over Bangladesh.

Objective

- To provide patient's service for cancer detection and radiotherapy through medical physics techniques
- To build up skilled radiation oncologists, medical physicists and technologists through academic and specialized training
- To establish a Cyclotron facility for the production of isotopes and Brachytherapy facility in order to clinical useand multidisciplinary research.

Activities

1. Manpower Development and Training Program

Title	Venue	Date	Duration	Participants
Training on instrumentation & clinical applications of Philips PET-CT.	Hospital Universitario Nuestra Senora de Candelaria, Spain	14-27, July, 2019	14 days	1 Physicist, 1 Physician, 1 technologist
Regional training course on basic radiation dosimetry molecular biology & radiology fo radiotherapy medical physics.	Kuala Lumpur, Malaysia	18-22, Nov, 2019	5 days	1 Physicist
Training Program on Radiation Oncology and Dose Delivery.	Hope Regional Cancer Centre, USA	8-17, Dec, 2019	10 days	3 Physicists, 1 Physician
Cyclotron Operation	Chiang Mai University, Thailand	23-12-19 to 05-01-2020	14 days	1 Physicist, 2 others
Cyclotron Radio- pharmacy and Related Information Management	Chiang Mai University, Thailand	20-31, Jan, 2020	12 days	2 Physicists, 2 others

2. Quality Control (QC)

Name of Equipment	QC	Times	Name of using appa./device
LINAC	Absolute Dosimetry	30	Solid phantom
		10	Water phantom
	Relative Dosimetry	4	3D water phantom
PET CT	Air Calibration of CT	48	-
	Image Quality of CT	55	CAT phantom
	PET QC	68	^{22}Na source

3. Training program/Workshop/Seminar/Symposium/Conference Arranged

Total 27 (twenty seven) local/internal seminars were arranged at auditorium of INMP, Savar from July, 2019 to June, 2020. All lectures are delivered by the officers and staffs of INMP according to their own specialized field.

4. Booklet

Abstract on "Comparison Between Free Breath and Deep Inspiration Breath Hold Techniques and Advantages for Left Breast Cancer in Radiotherapy", pulished in the Booklet of MMP Thesis (5^{th} Cycle), ICTP, M. M. Parvej, P. Chiovati and C. Cappelletto.

5. Service Rendered and Revenue Income

Mon	PET CT Scan		Qy of CT Simulation	Radiotherapy					
				3D CRT		IMRT		Follow up	Income
	Qty	Income		Plan	Fraction	Plan	Fraction		
Jul. 2019	31	930000/-	12	9	180	3	55	12	84100/-
Aug. 2019	36	1080000/-	12	12+1[b]	210	1	20	14	78000/-
Sep. 2019	28	840000/-	23	21	370	2	40	23	138900/-
Oct. 2019	29	870000/-	20	17	276	3	60	20	122100/-
Nov. 2019	43	1272000/-[a]	25	24	440	1	20	25	148800/-
Dec. 2019	38	1140000/-	15	13	250	2	40	15	98100/-
Jan. 2020	14	420000/-	13	11	210	2	40	13	85900/-
Feb. 2020	41	1230000/-	19	14	280	5	100	19	137400/-
Mar. 2020	17	510000/-	17	12	240	3	60	17	105100/-
Apr. 2020	0	0	0	0	0	0	0	0	0[c]
May. 2020	0	0	0	0	0	0	0	0	0[c]
Jun. 2020	36	1080000/-	24	16	302	8	160	24	177200/-
Total	213	9372000/-	181	150	2758	30	595	182	1175600/-

a. Respected to a Freedom Fighter = 18000/-, b. Manual plan and c. For the epidemic of COVID-19, all kind of patient's service was stopped due to lockdown respected toGOVT. order from 25th March, 2020 to 31th May, 2020.

Grand total income: (9372000/- +1175600/-) = 10547600/-

BEACH SAND MINERALS EXPLOITATION CENTRE (BSMEC), COX'S BAZAR

Objective/Introduction

Study on heavy minerals at the coastal and fluvial environments of Bangladesh; marine Environ. radioactivity and trace metal monitoring and measurement in sediments and sea water. Following specific programs are being carried out to fulfill the major objectives-

- Exploration for economic placer minerals in the coastal and fluvial depositional environments of Bangladesh
- Routine laboratory and plant processing of placer sands
- Comparative study on the occurrence, distribution, mineral composition and characteristics of heavy and radioactive minerals from coastal and fluvial environments of Bangladesh
- Effect of heavy mineral deposits on ground water quality along the southeastern coast of Bangladesh
- Determining radionuclides and trace elements in the sediments and seawater of southeast coast
- Study on marine and coastal Environmental radioactivity.

Activities

1. Research and Development Work(s)

1.1 Exploration for heavy mineral and radioactivity in tertiary sediments at hilly areas

M. Rajib and M. F. Hossain

Geological exploration was carried out at hilly areas of Cox's Bazar and Bandarban for the investigation of heavy mineral presence as well as any radioactivity presence in tertiary sediments. A scintillation radiation survey meter (Model SMGE 12#090202) and a portable radiation dose rate meter (Model MDGE 11#101201), calibrated with ^{137}Cs source, were used to determine the amount of radioactivity in counts per minute (cpm) and micro-Sievert per hour (μSv/hr), respectively, in the hilly areas along Chattogram-Cox's Bazar highway and Cox's Bazar-Bandarban link road. Hills of these areas are composed of tertiary sediments and sandstones from mostly Dupitila and Tipam ages are exposed along the roads. Survey was conducted in those sands through in-situ radioactivity measurement and collection of samples at corresponding locations. No anomalies of radioactivity were observed in any formation. Collected sands are prepared for further laboratory analysis.

1.2 Laboratory analysis for economic mineral exploration in fluvial sediments of Bangladesh

M. Rajib and M. F. Hossain

Geological field survey was carried out at Gorai River, a major tributary of the River Padma in Kumarkhali Upazila, Kushtia Districts for the exploration of economic minerals in fluvial environment. Gorai River is under dredging project for last several years for the suitable navigability. However, after dredging, the sands from the middle of the river are kept just on the bank. Therefore, survey was conducted to identify any economic minerals present in the dredged materials. Bromoform separation technique and microscopic grain counting was applied to quantify potentially economic minerals present in the dredged materials of Gorai River sediments. Heavy mineral concentration was determined as 3.2 to 4.6% in collected samples, where ilmenite, garnet, kyanites are found as major minerals. Having nearly 95% light fraction in these fluvial sands, physical upgradation of silica from is going on with density, magnetic and electric separator. This upgraded silica can potentially be used as glass producing which was found in other research of BSMEC. A collaborative research work is being going on with Dept. of Geological Sciences, Jahangirnagar University.

1.3 Heavy minerals in recent depositions at the Cox's Bazar coast and their mining feasibility

M. Rajib and M. F. Hossain

Collaboration research is going on with Dept. of Petroleum and Mining Engineering, Jashore University on the mining feasibility of the heavy minerals present in the recent depositions at the southeastern coast of Bangladesh. As many as 39 samples were collected from 13 various locations of beach areas of Kutubdia, Matarbari, Sonadia, Moheshkhali, Cox's Bazar, Himchari, Inani, Patuartek, Teknaf. Heavy minerals were found as high as 46% at some locations where major beach placers were identified with microscopic grain counting analysis. Mining considerations were analyzed in terms of potential reserve estimation of economic minerals, operation and maintenance cost of sand extraction, environment and socio-economic aspects. Finally, economic values of minerals were calculated in terms of their market values. It was found that heavy mineral extraction from recent beach depositions at Cox's bazar coast is not suitable, mostly due to environment and social perspective. However, if the deposits could be found at locations without or minimum human interference (such as river bars), such mining activity could potentially be sustainable.

1.4 Effect of gamma irradiation on beach placers of Bangladesh

M. Rajib, M. F. Hossain, T. Saha and M. Hossain

Major beach placers of Bangladesh, such as ilmenite, magnetite, rutile, zircon, garnet along with potential monazite concentrated and silica have been undergone irradiation by Co-60 gamma irradiator of initial source activity of 12000 Curie at Sterile Insect Technique (SIT) Unit, located at BSMEC campus. Objective of this research is to observe any effect of gamma irradiation to the morphology and composition and thereby obtaining information of possibility of synthesizing any mineral. Individual minerals were separated from beach sand and upgraded to best possible physical grade by density, magnetic and electric separators and

taken in testubes for irradiation. 10000 Gy gamma dose was provided by the Co-60 source (with present source activity of 9511 Ci) which took 4h 21m 1 sec (15661 seconds), with 100% source efficiency. Microscopic observation, X-ray diffraction analysis and elemental composition will be determined after irradiation and comparison will be made with the initial mineral samples.

1.5 Potentiality of intertidal foraminifera to assess sea-level changes of Bangladesh through determination of oxygen and carbon-isotopes

T. Saha, M. F. Hossain and M. Rajib

Study on the contemporary intertidal foraminifera and estuarine environment information from south-western coastal region of Bangladesh revealed that foraminiferal assemblages came from the inner shelf under the influence of tide and wave action and deposited on the marsh zone as a transgression of sea. This integrated study can be utilized for the Holocene sea level rise on the basis of benthic foraminiferal assemblages through oxygen and carbon-isotopes, both qualitatively and quantitatively. Oxygen-isotope compositions of individual shells represent the Environ. condition for that period and different species of foraminifera will be useful to identify the differences in oxygen-isotope vital effects. Determination of such isotopes in marine environments could be a potential area of future geoscientific research of BAEC.

1.6 Ground water monitoring at the coastal area of Cox's Bazar

M. F. Hossain, T. Saha and M. Rajib

A research has been initiated to monitor the ground water quality at the Cox's Bazar coast. Objective of the study is to observe the effect of heavy mineral and radioactive materials to the physical and chemical condition of ground water coming from shallow tube wells of the region. As case study, physical parameters such as pH, EC, TDS, temperature were measured to the water samples of various wells of BSMEC campus. In addition, water in the observation wells of Bangladesh Water Development Board, located in BSMEC campus, was also measured. A total of 10 wells were brought under observation to compare with previous data of BSMEC. As continuation, the same research will be extended to other parts of the coastal area. Initiatives are taken to measure the cations, anions and other chemical parameters in collaboration with Dept. of Public Health Engineering, Cox's Bazar.

2. Manpower Development and Training Program

2.1 Arranged Training Program

Title of the event	Date	Place	No. of participants
In-house Training for BSMEC Employees	1-5 Dec. 2019	BSMEC	11
In-house Training for BSMEC Employees	14-15 Jan. 2020	BSMEC	11
In-house Training for BSMEC Employees	18-19 Jan. 2020	BSMEC	10
In-house Training for BSMEC Employees	2 Mar. 2020	BSMEC	11
In-house Training for BSMEC Employees	7-8 Jun. 2020	BSMEC	10
Industrial Training to BSc students (Level-3, Term-2) of Military Institute of Science and Technology (MIST), Dhaka, Cantonment	8-11 Dec. 2019	BSMEC	40

2.2 Arranged Seminar Program

Title of the event	Date	Place	No. of participants
Seminar on R&D activities of BSMEC	20 Aug. 2019	BSMEC	5
Seminar on R&D activities of BSMEC	14 Sept. 2019	BSMEC	13
Seminar on R&D activities of BSMEC	09 Jun. 2020	BSMEC	11
Technical Session on the visit of Physical and Engineering Research Evaluation Committee of BAEC.	16 Jan. 2020	BSMEC	29

2.3 Attended Training Program

Name of the participant	Title of the event	Organizer	Date	Place
Dr. M. Rajib	IAEA Project Review Meeting INT 2019- Deploying Technology and Management of Sustainable Uranium Extraction Projects	IAEA and East China University of Technology	11-15 Nov. 2019	Nanchang, China
	CTBTO-NDC Capacity Building Workshop and Regional Seismic Travel Time (RSTT) in combination with Data Sharing and Integration Training	CTBTO	28 Oct.-1 Nov. 2019	Chiang Mai, Thailand
	Public procurement process and approval procedure	BIM	26-29 Aug. 2019	BIM, Dhaka
	Joint ICTP-IAEA School of Nuclear Knowledge Management	ICTP	5-9 Aug. 2019	Trieste, Italy
M. F. Hossain	সরকারী অফিস ব্যবস্থাপনা ও দক্ষতা উন্নয়ন	BIM	28-29 Jul. 2019	BIM, Dhaka
	Project Management	BIM	26-28 Sept., 2019	BIM, Dhaka
M. M. Islam	Radiation Protection for Radiation Workers RCOs of BAEC, Medical Facilities & Industries	BAEC	15-19 Aug. 2019	TI, AERE
M. M. Rahman	সরকারী চাকুরীর অত্যাবশ্যকীয় নিয়মাবলী	BIM	13-14 Oct. 2019	BIM, Dhaka
M. S. Islam	সরকারী অফিস ব্যবস্থাপনা ও দক্ষতা উন্নয়ন	BIM	28-29 Jul. 2019	BIM, Dhaka
	সরকারী চাকুরীর অত্যাবশ্যকীয় নিয়মাবলী	BIM	13-14 Oct. 2019	BIM, Dhaka

***** Bangladesh Institute of Management

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

Name of the Participant	Title of the event	Organizer	Date	Place
Dr. M. Rajib	International Conference on Earth & Environ. Sciences and Technology (ICEEST-2020)	Faculty of Earth and Environ. Sciences, DU	25-30 Jan. 2020	Hotel Intercontinental, Dhaka
M. F. Hossain	International Conference on Computer, Communication, Chemical and Mechanical Engineering (IC4ME2)	Faculty of Engineering, RU	11-12 Jul. 2019	RU

4. Collaboration Work/MoU

Joint research with Bangladesh Oceanographic Research Institute (BORI), Cox's Bazar on "Economic mineral resource exploration in the coastal area of Bangladesh".

5. Academic and Industrial Visit of University Faculties, Students and Professionals

Name of the organization	Date	No. of participants
Dept. of Environ. Sciences and Disaster Management, Daffodil International University (DIU)	07 Oct. 2019	27
Marine Engineering Specialization Course, BNS Shahid Moazzem, Bangladesh Navy	13 Oct. 2019	12
Bangabondhu Sheikh Mujibur Rahman Maritime University (BSMRMU)	20 Oct. 2019	38

Name of the organization	Date	No. of participants
Dept. of Petroleum and Mining Engineering, Jashore University of Science and Technology	10 Dec. 2019	27
Dept. of Environ. Science, Bangladesh University of Professionals (BUP)	10 Dec. 2019	49

ATOMIC ENERGY CENTRE (AEC), CHATTOGRAM

Objective/Introduction

- Ensure safety of food and environment from radioactive contamination
- Monitoring and assessing of pollution level in marine and coastal environment due to nuclear activities or radioactive waste disposal
- Promote research and development activities on Environ. issues
- Expand cooperation with other scientific organizations, universities, private and public sectors through mutual exchange of educational programs, training, technical cooperation and expert services
- Develop human resources in the field of nuclear science and technology.

Activities

1. Research and Development Work(s)

1.1 Monitoring and assessing of radiation level in marine, non-marine and coastal environment due to nuclear activities or radioactive waste disposal

S. Hossain, N. Deb, S. R. Talukdar, C. K. Mahmud, M. Ahmed, N. Khatun, N. S. Resma and M. Debnath

The objective of this program is to protect human life, property and environment from undue radiation hazard by means of exposure control and radioactivity monitoring of the Environ. elements. Different point and non-point sources existing in the environment or industries can cause radiation hazard. Establishment of base-line data for the background and other radiation sources in the country is another vital issue. Several programs would be initiated towards individual and environment monitoring and radiation safety such as radiological impact assessment of waste management and disposal practices; establishment of benchmarks for assessing the radiological impact of the nuclear power activities on the marine environment in the Asia Pacific Region and related radioecology studies, personnel monitoring services to all radiation workers and support to the regulatory authorities in assessment of genuineness of dose for overexposure situations would be provided. Several training and certification courses in radiological physics and safety would be conducted regionally on a regular basis. Research work which have been done and going on under this section are given below:

1.1.1 Radiological status in river water collected from the Karnaphuli and Halda river of Chittagong, Bangladesh

Although the Karnafuli and Halda rivers are most important for their contribution in ecological and commercial, but no data on radioactivity in two rivers are reported elsewhere. The mean activity concentrations (Bq/kg) for natural radionuclides ^{226}Ra, ^{232}Th and ^{40}K in water collected from different important location of these two rivers were found to be 5.5±0.9, 6.9±1.2 and 277.4±16.0 respectively; all lie within the respective world average values of 35, 35 and 450 Bq/kg respectively. Thus, the water of Karnafuli and Halda rivers pose an insignificant radiological threats to the livelihood of Chittagong city who use river water, also the population of Bangladesh who consume the fresh water fish.

1.1.2 Research Title 2: Study of natural radioactivity and heavy metal in some marine biotic collected from the northern coastal belt of the Bay of Bengal, Chittagong, Bangladesh

A comprehensive study was planned and carried out to provide the information of radioactivity level (^{226}Ra, ^{232}Th, ^{40}K and ^{137}Cs) and heavy metal concentration (Cd, Pb, Zn, Cu, Ni, Fe, Mn and Cr) in some locally available commercially important seven fish and three crab species. All the fish samples were collected directly from the fishing trawler and crab samples from the two locations of the coastal belt of the Bay of Bengal, Chattogram region at two different seasons. The activity concentration obtained for ^{226}Ra is 4.5±2.25

Bqkg^{-1}, which is only found in *Harpodon neherues*. The activity concentration of 232Th ranges from 5.0±2.0 Bqkg^{-1} to 188.5±13.2 Bqkg^{-1} and the average value stands at 67.14±8.93 Bqkg^{-1} and the activity concentration of ^{40}K ranges from 134±42.2 Bqkg^{-1} to 355±38 Bqkg^{-1} and the average is 245.45±49.92 Bqkg^{-1}. There is no Anthropogenic radionuclide (^{137}Cs) in any samples. Among all the samples the average annual effective dose for ^{226}Ra and ^{40}K has been found within UNSCEAR acceptable limits. Though the average annual effective dose for ^{232}Th is 3 times greater than UNSCEAR acceptable limits but total values of annual effective dose and Excess lifetime cancer risk lies within the acceptable limits. The values of the Internal Hazard index which is less then unity indicate that there is no hazardous effect on the respiratory organs of the public. By the analysis with Atomic Absorption Spectrophotometer (HITACHI Z - 2000) the obtained heavy metal and trace element concentrations in ten marine fish and crab samples at rainy season followed the order of Fe> Mn>Zn>Cu>Ni>Cr>Cd>Pb and in the autumn season the concentrations of the heavy metals were found to decrease in the sequence of Fe>Mn>Zn>Cu>Cr>Pb>Cd>Ni. According to the values of estimated daily intake (EDI), target hazard quotient (THQ), hazard Index HI (Total THQ) and the permissible safety limits prescribed by various organizations, consumption of the examined fish and crabs should be considered as safe for human health. However, the Target Cancer Risk (TR>10^{-4}) due to exposure of Cadmium, Nickel and Chromium indicated that consumers remain at risk of cancer.

1.1.3 Evaluation of activity concentration of natural radioactivity elements ^{226}Ra, ^{232}Th and ^{40}K in the sample of Feni river Bangladesh

The Activity Concentrations of naturally occurring radioactive elements ^{226}Ra, 232Th and 40K in the sediment samples collected from Feni River, Bangladesh has been determined by using HPGe gamma ray spectrometry system. The activity concentration, absorbed dose rate, annual effective absorbed dose rate and the radiation hazard indices for these samples has been evaluated. The individual dose rates for the samples have been found to be somewhat similar to the reported world average value. The Radium equivalent activity has also been found to be lower than the value reported in UNSCEAR-2000. Correlation coefficients have also been calculated for radium-thorium and radium-potassium concentrations. A strong correlation between the concentrations of ^{226}Ra and ^{232}Th and poor correlation between the specific activities of 226Ra and 40K in the samples has been observed. The average activity concentration of 40K has been found to be 255.78±58.112 Bq.kg $^{-1}$ within the range of 224.34±40.387 to 549.59±98.531 Bq.kg $^{-1}$ for surface and for 30 cm depth with an average value 92.918±60.084 Bq.kg -^{1}within the range 233.29±79.566 to 497.29±79.566 Bq.kg $^{-1}$. The activity concentration of ^{232}Th has been found to be in the range of 15.33±3.83 to 52.27±8.36 Bq.kg $^{-1}$ for surface with an average value 34.84±6.69 Bq.kg $^{-1}$ and 18.33±3.85 to 55.49±8.32 Bq.kg $^{-1}$ for 30 cm depth with an average value 40.37±6.72 Bq.kg $^{-1}$. The activity concentration of ^{226}Ra has been found to be in the range of 8.45±1.94 to 25.68±4.88 Bq. Kg^{-1} for surface with an average value 18.03±3.56 Bq.kg $^{-1}$ and 8.15±2.04 to 24.97±4.49 Bq.kg $^{-1}$ with an average value 18.62±3.68 Bq.kg -1. Any artificial radionuclide has not been detected in the sediment samples collected from the study areas. The mean value of Radium equivalent activity has been found 99.5834 Bq.kg^{-1} within the range 49.4989 to 138.8974 Bq.kg^{-1}. The average value of absorbed dose rate has been found 4.69×10-5 mSv.h^{-1} which is lower than the measured absorbed dose rate by survey meter. The value of annual effective dose rate, external and internal health hazard has been calculated and has been found 0.0576 mSv.y^{-1}, 0.2722 and 0.631 respectively.

1.1.4 Concentration of naturally occurring radioactive elements ^{226}Ra, ^{232}Th and ^{40}K in the sediment samples of Muhuri river, Bangladesh

This study has been carried out to find the concentration of radioactive nuclides ^{226}Ra, ^{232}Th and ^{40}K present in the sediment samples collected from 15 stations of Muhuri River, Bangladesh. Total of 30 sediment samples have been collected. From each location two samples have been collected, one from the surface level and another from 30 cm depth of the surface level. The samples have been analyzed by a High Purity Germanium (HPGe) detector for the radioactive elements mentioned. At the surface level, the specific activities of ^{226}Ra, ^{232}Th and ^{40}K have been found to be in the ranges of 15.68 ± 3.45 Bq kg^{-1} to 32.37 ± 6.15 Bq kg^{-1}, 33.14 ± 4.97 Bq kg^{-1}'to 73.91 ± 14.78 Bq kg^{-1} and 286.73 ± 48.74 Bq kg^{-1} to 555.68±94.47 Bq kg^{-1} with average values of 21.58 ± 4.34 Bq kg^{-1}, 48.40 ± 9.49 Bq kg^{-1} and 374.41 ± 64.62 Bq kg^{-1}, respectively. At 30 cm depth from the surface level, the activity concentration of ^{226}Ra, ^{232}Th and ^{40}K have been found to be in the ranges of 5.98 ± 2.39 Bq kg^{-1} to 24.65 ± 4.68 Bq kg^{-1}, 20.08 ± 3.61 Bq kg^{-1} to 55.94±11.75 Bq kg^{-1}

and 42.61 ± 17.04 Bq kg^{-1} to 489.36 ± 83.19 Bq kg^{-1} with average values of 19.72 ± 3.94 Bq kg^{-1}, 47.64 ± 9.54 Bq kg^{-1} and 336.56 ± 58.44 Bq kg^{-1}, respectively. The estimated average activity concentrations of ^{226}Ra and ^{40}K have been found to be lower than those of the world average values while the average activity concentration of ^{232}Th has been found to be slightly higher than that of the world average value. The average values of radium equivalent activity, absorbed dose rate and annual effective dose rate have been found to be 114.21 Bq kg^{-1}, 53.47 nGy h^{-1} and 0.065 mS y^{-1}, respectively. Also, the average values of external and internal hazard indices have been found to be 0.315 and 0.370, respectively. The estimated values of all radiological hazard indices are lower than those of the world average values.

1.1.5 Elementary contaminants and radioactivity levels of effluent discharged from different industries to Murari Khal, Patiya, Chittagong, Bangladesh

The specific aims of objectives of the present work are-to measure the amount of natural radionuclides in the sediments plus toxic elements and to study the characteristic manners of naturally occurring radioactive elements and heavy metals in the investigated samples. Two types of samples -sediment and water sample have been collected from some selected sites of Murari Khal, Patiya of Chittagong with necessary precautions. The geographical location of sampling points has been recorded by using GPS. Here, number of water sample is forty and the number of soil sample is also forty. The activity concentrations of ^{238}U, ^{232}Th and ^{40}K (in $Bqkg^{-1}$) of 40 samples have been measured using HPGe γ-ray spectrometry and the data processing and analysis is being carried on. In addition, all the forty samples of sediment have been digested and prepared for the quantitative analysis of heavy metals. The concentrations of heavy metals of 80 samples are yet to be determined by **Atomic Absorption Spectrophotometer (**AAS) as the analysis is deterred due to instrumental problem of AAS.

1.1.6 Distribution of radionuclides and heavy metals in sediments and mangroves in the coastal zone of Sandwip, Chattogram

The present study aims is to assess the current Environ. condition by determining the mass concentration of radionuclides and distribution of various heavy metals in mangrove sediments, plants and to estimate a possible anthropogenic input by comparing sediments of Sandwip costal area. Following some precautions the samples (sediment and mangroves) were collected from some coastal areas of Sandwip Island of Chittagong district. The geographical location of sampling points was recorded by using GPS. For the nondestructive measurement of radioactivity using HPGe γ- ray spectrometry, samples were prepared through following steps. All solid samples were dried under the direct sunlight for several days to evaporate the water and after that samples were oven dried at 110^0C until constant weight was found. The dried samples were ground with agate mortar. For measuring the activity concentration due to natural radionuclides the powdered sample were weighed and then taken into individual cylindrical plastic container. After settling the sample in the plastic container homogeneously, the samples were kept equal in volume to the standard γ-ray source material. Water samples were prepared according to the instruction of IAEA. The containers were sealed tightly and wrapped with thick vinyl tapes around their screw necks. For heavy metal analysis the samples were prepared according to international guidelines and analysis will be done as per schedule**.**

1.2 Assessment of heavy metal contamination in various bio-geo-Environ. samples

S. Hossain, N. Deb, S. R. Talukdar, C. K. Mahmud, M. Ahmed, N. Khatun, N. S. Resma and M. Debnath

The objective of this program is to provide advanced analytical facilities to the different researchers and continue research activities to develop and establish methodologies for analyzing trace (both toxic and essential) elements in samples of different matrices. Present program is rendering analytical services to the clients and pursuing R&D activities focusing the socio-economic development of the country, especially in the field of Environ. pollution such as; air, water and soil etc. Research work which have been done and going on under this section are given below:

1.2.1 Assessment of spatial variability of heavy metal hazard in road deposited sediment using road network under Chittagong city corporation

Environ. pollution is one of the burning issues in the contemporary developing countries. In relation to this, urban road network is often found to be enriched with certain heavy metals associated with road dust derived

from the road traffic environment that not only pose hazard to the nearby aquatic lives but also directly affecting the city dwellers exposed of particulate matter of road dust. It is evident that this phenomenon is highly site specific. Hence, a detailed investigation has been conducted to assess the heavy metal hazard associated with road deposited sediment using samples collected from 32 major roads sites of Chittagong City covering urban road network characteristics with seasonal variation in considerations. The total concentration of Zn, Pb, Cr, Cu, Ni, Cd in road fine suspended dust was determined by Polarized Zeeman Atomic Absorption Spectrophotometer (Hitachi Z-2000) followed by acid digestion. The average heavy metal concentrations over the sites for Zn, Pb, Cr, Cu, Ni, Cd were found as 974.37, 84.16, 77.16, 74.13, 31.86, 1.63 mg/kg respectively. The concentrations were generally found in accordance with the studies elsewhere and in compare with different relevant guidelines, the concentrations were 1.20 to 5.57 times higher than pre-industrial reference value that confirms the anthropogenic input derived from the road traffic environment. The contamination level was assessed using degree of contamination, potential ecological risk index and integrated pollution index. Taking degree of contamination in consideration, Zn showed the highest contamination level followed by Cu, Pb, Cd, Cr, Ni. Based on potential ecological risk and pollution indices, a considerable to moderate pollution risk associated with road dust was noticed to be present in the road network of the study area.

1.2.2 Studies of naturally occurred radioactivity and heavy metals concentration in wild mushrooms in Chittagong Hill tracks area of Bangladesh

Wild mushrooms are considered as bioindicators of Environ. pollution. Different species of mushrooms (edible and medicinal), commonly available in Chattogram hill tracts (CHT) area of Bangladesh, were analyzed for prevailing concentrations of heavy metals and radioactive materials via atomic absorption spectroscopy and γ-ray spectrometry, respectively. The metal contents in some species show higher than the levels recommended by WHO/FAO for metals in food and vegetables. In case of terrestrial radionuclides, the concentrations of ^{232}Th and ^{40}K exceeded the global average value of 82 Bq/kg and 310 Bq/kg, respectively (UNSCEAR, 2000). Since the studied mushroom grew naturally, the obtained results provide useful information on the presence of radioactive, toxic and essential elements in the CHT area which may require for any further study of other Environ. matrices in this area.

1.2.3 Studies of the elementary contaminants and radioactivity level of the effluents from different industries exposed to Murari Khal (Canal), Potiya, Chittagong

For this study, sample collection and preparation has been completed for being studied by AAS. The aim of the study is to evaluate the effect of effluent pollution and radioactive contamination from different industries if exists in Murari Khal & to find out some remedial measures. Others measurement and analysis of the study are going on.

1.2.4 Distribution of radionuclides and heavy metals in sediments and mangroves in the coastal zone of Sandwip, Chattogram

The present study aims to assess the current Environ. condition by determining the mass concentration of radionuclides and distribution of various heavy metals in mangrove sediments, plants. For carrying out the study, all kinds of sample has been collected and prepared for being analysis of heavy metals. Others measurement and analysis of the study are going on.

1.2.5 Natural radionuclides and heavy metal content in sand, sediment and water samples of parkir chor beach, Anowara, Chittagong, Bangladesh

The results under this study would be useful as a baseline data supporting the heavy metal and Environ. radiation surveillance program of the country. To continue this study, samples has been collected and prepared for being studied by Atomic Absorption Spectrophotometer. Others measurement and analysis of the study are going on.

1.2.6 Exploration of Elemental Profile and Bio-active Phytochemicals of Some Medicinal Plants Traditionally Used in Chattogram Hill Tracts, Bangladesh

The basic and fundamental target of this study is to identify the minerals, vitamins and active constituents and their correlation with pharmacological effects of some medicinal plants available in Chittagong hill tracts.

And also to determine NORMS specific activity concentration and annual effective doses in plants which is not only important because of the risk associated with it but also from the fact that some of them can be used as biochemical tracer in the human food chain. Others measurement and analysis of the study are going on.

1.2.7 Analysis of Trace Elements and Bioactive Phytochemicals of Some Ethnomedicinal Plants Used in Chattogram Hill Tracts

The basic and fundamental target of this study is to identify the existing elements of some medicinal plants of Chittagong hill tracts and their correlation with different types of pharmacologic effects. Others measurement and analysis of the study are going on.

1.3 Environ. monitoring and impact assessment due to chemical and industrial hazard across the country

S. Hossain, N. Deb, S. R. Talukdar, C. K. Mahmud, M. Ahmed, N. Khatun, N. S. Resma and M. Debnath

In recent years, Environ. issues are playing an increasing role in the consideration of options available for energy production. In the context of fossil power, thermal power and nuclear power, Environ. protection and public safety are inextricably linked to the setting up, operation and maintenance of the entire fuel cycle facilities. In addition, due to expanding trend of industrialization especially in the sector of garment manufacturing, textiles, fertilizer industries, chemical industries, tanneries etc. safe environment are at risk. Broadly speaking, these pertain to the protection of occupational workers, general public and the environment at large. Therefore, comprehensive research and development activities on Environ. impact and risk assessment for chemical and industrial contaminants are required which will cover both meteorological and hydro-geological investigations for contaminated/non-contaminated sites. Modeling of contaminant transport and dispersion in the atmosphere and hydrosphere would be done. Research work which have been done and going on under this section are given below:

1.3.1 Investigation of heavy metals in waste liquids discharged by the concerned factories at Kalurghat Industrial Area, Chittagong, Bangladesh

In this investigation the waste products in liquid form discharged by the different types of industries like garments, dying, food, paint, paste, paper at Kalurghat Industrial Area, Chattogram, Bangladesh were analyzed for metallic elements Fe, Cu, Mn, Pd and Cd. The concentrations of these heavy metals were obtained by atomic absorption spectrophotometer (AAS) analysis with flame atomizer. The investigation showed that the waste liquids of all types of selected industries contained all the investigated elements where the highest concentration of Fe (17.84 ppm) was found in the waste liquids of Garments industries and the highest concentrations of other investigated elements Cu, Mn, Pb and Cd (Cu-1.93; Mn-1.98; Pb-1.94 & Cd-1.04 ppm) were found in the waste liquids of Dyeing factories. Moreover, the maximum values of Fe, Cu, Mn and Pb were found lower than the permissible limit of plant and soil. The maximum values of Cd were found higher than the permissible limit of plant, water and soil. The maximum values of Fe, Mn, Pb and Cd were found higher than the permissible limit of water. The maximum value of Cu was found lower than the permissible limit of water. The overall investigation showed that the waste liquids may be considered for cultivated area but not for drinking water. However, the discharge of this wastewater into the open field or in the river may play a role to increase the heavy metal pollution in the environment and in changing the ecosystem of the cultivated area.

1.3.2 Assessment of heavy metal concentration in Mirershorai economic zone

Mirersarai Economic Zone (MEZ) will be the first multi-sector EZ in the country, with an existing area of 6,615acres and it is also proposed that an additional area of 580 acres of land to be reclaimed from the sea. Formal establishment of the EZ is expected to immediately address the huge demand for industrial plots among both the local and foreign investment communities. Many industries, including power plants, iron processing industries, Garments, integrated textile industries, paint and chemical industries, automobile parts

and motorcycle assembly, food and beverage industries, plastics etc. are going to be established in Mirersarai Economic Zone. Due to the activities of these industries the surrounding area of the Economic Zone, especially nearby coast of the Bay of Bangle will be in the risk of heavy metal contamination in the future. So, the specific aims of the present work are to assess the heavy elements as well as toxic elements in the investigated soil/sand samples and to determinate the concentration of heavy metals in water sample. An extensive study was carried out to assess the distribution and concentration of different water qualities of the investigated area. Samples were collected from different points in the hydrological year 2019. The maximum and minimum values of physico-chemical parameters such as pH, Water Temperature, pressure and EC were 8.39 to 6.58, 31.81 to 24.77°C, 1.006 to 0.997 atm and 9608 to 40.82 µsTm. The soil and sediment samples were first sun dried for several days then each of the samples were dried in an electronic oven at above 80°C for 2-3 day to remove all the moisture. The dry samples were finely grounded with mortar and pestle. The powdered samples were contained in polyethylene bags and preserved. Then the powdered samples have been digested according to standard procedure. Analysis of heavy metal concentration will be done as per schedule. This investigation would help us to assess the heavy metal pollution status in Mirershorai Economic Zone as well as to establish a baseline database of heavy metals and radionuclides on that site which might become an essential reference guide for the future.

2. Training program/Workshop/Seminar/Symposium/Conference/Study Tour Arranged

Title of the event	Date	Place	No. of participants
Seminar on of M. Phil. Thesis	15 Sept. 2019	AECC	20
Seminar of MS Thesis Students	27 Nov. 2018	AECC	25
Stakeholder Meeting	03 Dec. 2019	AECC	40
Public Hearing	18 Dec. 2019	AECC	40
Seminar on Advance Radiation Monitoring Solution of Mirion Technologies (MGPI) SA France	21 Jan. 2020	AECC	40

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

Name of the participants	Title of the event	Organizer	Date	Place
Dr. S. Hossain	Technical Meeting on Advanced Radiation portal Monitor testing and Configuration Technique	IAEA	29 Oct.- 1 Nov. 2019	Austria, Vienna
	Development of Standard Operating Procedure (SOP) for Radiation Portal Monitors (RPM) installed at the port of Chittagong under Megaport Initiative Project	NNSA, USA	12-16 Jan. 2020	Hotel Radisson Blue, Chattogram
S. R. Talukdar	IAEA/RCA Regional Training Course on Dose Assessment and Risk Analysis Modeling	IAEA	28 Oct. - 1 Nov. 2019	Hangzhou, Zhejiang, Chaina
B. K. Mahmud	IAEA/RCA Regional Training Course on Dose Assessment and Risk Analysis Modeling	IAEA	28 Oct. - 1 Nov. 2019	Hangzhou, Zhejiang, Chaina
M. Ahmed	TC Postgraduate Educational Course in Radiation Protection and The Safety of Radiation Sources PGEC16-2019, Kajang, Malaysia	IAEA	17 Jun.- 13 Dec. 2019	Kajang, Malaysia.
	International Conference on Physics - 2020	BPS**	5-7 Mar. 2020	AECD

Name of the participants	Title of the event	Organizer	Date	Place
M. Debnath	International Conference on Physics - 2020	BPS	5-7 Mar. 2020	AECD
M. M. Rahman	Public Financial management	NPDA*	28 Jul. - 01 Aug. 2019	NPDA*, Dhaka
B. Shill	Training Course on` Radiation Protection for Radiation Workers and RCO's of BAEC Medical Facilities and Industries.	TI, AERE	14 -20 Sept. 2019	TI, AERE

****** Bangladesh Physical Soceity, *****National Planning and Development Academy

4. Collaboration Work

4.1 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 or not nuclear and other radioactive material out of regulatory control is present when an initial alarm occurs.)

4.2 IAEA/RCA Project - RAS/7/028

Enhancing Regional Capabilities for Marine Radioactivity Monitoring and Assessment of the Potential Impact of Radioactive Releases from Nuclear Facilities in Asia-Pacific Marine Ecosystems. (Objective: To improve the integrated regional quality-assured capabilities for marine radioactivity monitoring and for impact assessment of routine and accidental releases of radioactivity into the marine environment.)

4.3 S&T Project -Gr Sl- 385ES

Assessment of radioactivity level and toxic metal concentrations of wild edible mushrooms grown in Chattogram hill tracts area of Bangladesh. (Objective: To evaluate the level of concentration of heavy metals, radionuclides and assess the effect of heavy metals on human health and environment)

5. Service Rendered and Revenue Income

Measurement of radioactivity in imported and exportable food and allied materials is carrying out according to NSRC Rule-1997, SRO No. 205-Law /97. The details are as follows:

Name of month	No. of sample tested	Income
Jul. 2019	1062	13799792/-
Aug. 2019	1156	13601090/-
Sept. 2019	1417	15665732/-
Oct. 2019	1702	16789069.22
Nov. 2019	1405	18562470.86
Dec. 2019	1746	20506695/-
Jan. 2020	1423	22673669/-
Feb. 2020	1201	19434963/-
Mar. 2020	1301	19091900/-
Apr. 2020	1238	18585709/-
May 2020	1394	16278230/-
Jun. 2020	1194	24540053/-
Total	16239	219529373.08

RADIATION TESTING AND MONITORING LABORATORY (RTML), MONGLA, BAGERHAT

Objective/Introduction

- 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 in Jashore.
- 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. Manpower Development and Training Program

Title of the event	Date	Place	No. of participant
Follow-up Training Course, FTC (Environmental Monitoring) and FTC (Emergency Preparedness)	24 Nov.-5 Dec. 2019 and 12-16 Jan. 2020	TI, AERE	2

2. Stakeholder Meeting

Meeting arranged with Mongla Port Authority (MPA) as MPA-Stakeholder, Main Office MPA, Mongla, Bagerhat, 17 Sept. 2019.

3. Project Work(s)

Under ADP Project of Development of HR and Establishment of Residential Accommodation Facilities for RTML

- Two residential building almost completed
- Electric connection, water supply system under process
- Connective road, walkway, guard house, pump-house, gardening works etc. under progress
- Landscaping and finishing works to be done shortly.

4. Others

Identification of orphan source (depleted uranium)- requisition from detective branch of Bangladesh police. (adjunct task with Health Physics Division, AEC, Dhaka)

5. Service Rendard and Revenue Income

Name of service	No. of sample	Income
Measurement of radioactivity in food	132	2541778/-

II. BIO-SCIENCES

INSTITUTE OF FOOD AND RADIATION BIOLOGY (IFRB), AERE, SAVAR

Agrochemical and Environmental Research Unit, IFRB

Objective/Introduction

Agrochemical and Environ. 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 Developemnt Work(s)

1.1 Heavy metal contents in surface water samples of some selected lakes in Chandpur district

M. Nesha, Z. Fardous, M. A. Rahman, M. A. Z. Chowdhury and M. A. Uddin

Heavy metal analyses were carried out on different lake water samples of Chandpur district. The results obtained from the study have been summarized and from the results, it appears that the As, Cr, Cu and Fe content in the surface water of the selected lakes were within a range of 0.0059-0.0128 ppm, 2.0291-4.025 ppm, 0-0.1995 ppm and 0.1776-4.1744 ppm respectively. The concentration of metals including As, Cu, Cd, Pb and Zn for the examined samples were found below the standard permissible limit set by WHO. The surface waters for the studied lakes were highly contaminated with C which is well known for its toxic, carcinogenic and mutagenic effects on humans and other living organisms. Several in vitro studies demonstrated that high concentrations of Cr in the cell can lead to DNA damage. In most of the sampling locations, Fe contents exceeded 0.3 ppm, the permissible limit for water set by WHO. The concentration of Fe in the study area is not suitable for food processing, drinking and many other activities. Heavier amount of Fe can cause serious health problems or premature death. Toxicity of Fe may damage the liver, heart and endocrine glands, leading to debilitating and life threatening problems such as diabetes, heart failure and poor growth. Thus, from these findings, it can be concluded that the surface water collected from the four selected lakes of Matlab Uttar Upazila, Chandpur is contaminated due to elevated concentration of Cr and Fe and not safe for drinking purposes.

1.2 Determination of Inorganic pollutants in dried fish of Saint Martin's island, Cox's Bazar

Z. Fardous, M. A. Rahman, M. A. Z. Chowdhury, M. Nesha and M. A. Uddin

Inorganic pollutants (Heavy metals & Trace elements) are non-biodegradable substances which cause serious carcinogenic effects on animals and humans. As fish occupy top position of aquatic food chain, it is a major source of heavy metal contamination. The concentration of Cd, Cr, Pb, Mn, Fe, Cu and Zn were with the range of 0.0156 - 0.1428, 0.163 - 8.53, 0.0924 - 0.4026, 9.38 - 65.9382, 0.0473 - 0.1981 and 0.1473 - 1.8148 ppm respectively for the fish samples of Cox's Bazar region while 0.0191 - 0.1386, 0.8445 - 0.1743, 0.102 - 0.4625, 0.102 - 0.4675, 9.7269 - 60.5267, 0.3108 - 0.046 ppm for the fish samples of Saint Martin's region. Comparatively high concentrations of heavy metals were found in Mola (Amblypharyngodon mola), Rupchanda (Stromateus chinensis) and Chhuri (Trichiurus lepturus). The order of heavy metal concentrations were Fe>Zn>Cr>Cu>Mn>Cd. The concentration of heavy metals varied from species to species and most of the metals were not significantly correlated, even some metals showed negative correlation among them. Concentration of Fe in some fishes (Mola, Rupchanda and Chhuri) was found higher than WHO guideline values, while other metals exhibited the value below the WHO standard. The results of this study will assist in acquiring information about the level of toxic metals in these regions and to improve the coastal management in these areas in future.

1.3 Assessment of organochlorine and organophosphorus pesticide residues in surface and underground water samples of Daudkandi Upazila, Comilla

M. Hasanuzzaman and M. A. Uddin

The farmers of Bangladesh mainly rely on pesticides for pest control to boost the crop production. This study was carried out to ascertain the presence and subsequent amount of some organochlorine and organophosphorus pesticide residues in water samples collected from pond, ditch and tube-well of Daudkandi upazila. Using the High Performance Liquid Chromatography (HPLC) a total of thirty water samples was examined to evaluate the suspected pesticide residues. Among the organophosphorus pesticides, diazinon was detected only in one water sample at a concentration of 651 µg/l, whereas, eleven water samples were found to be contaminated with malathion ranging from 1000 to 8200 µg/l. Chlorpyrifos was also detected only in one water sample at a concentration of 31 µg/l. None of the tested water samples was found to be contaminated with suspected organochlorine pesticide residues. On the other hand, tube-well water samples were totally free from suspected pesticide residues. Appropriate measures should be taken to lessen the over dependence on pesticide in agriculture and thus decrease the possible health risk of the people.

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

Name of the Participant	Title of the event	Organizer	Date	Place
Dr. M. A. Uddin, Dr. M. A. Z. Chowdhury, Dr. M. Hasanuzzaman, M. A. Rahman, Z. Fardous and M. Nesha	National Seminar on Nuclear Energy and Sustainable Development	BAEC	3 Feb. 2020	BAEC, HQ

Food Safety and Quality Analysis Division, IFRB

Objective/Introduction

Food Safety and Quality Analysis Division is basically involved in carrying out research on improvement of food quality (nutritional, functional and microbiological quality) and storage condition through conventional and nuclear technology for food safety and security aspects. Research works of FSQAD also focus on development of convenience food and food additives from different kinds of food and food derivatives. Area-wise analysis of elemental and heavy metal in agricultural and dairy products through nuclear techniques is also in progress to develop a database for food traceability and authenticity.

Activities

1. Research and Development Work(s)

1.1 Disinfection of *Bacillus cereus* bioflms on leafy green vegetables with slightly acidic electrolyzed water, ultrasound and mild heat

M. S. Hussain, M. Kwon, E. Park, K. Seheli, R. Huque and D. H. Oh

This study aims to examine the disinfection kinetics of slightly acidic electrolyzed water (SAEW) with mild heat and ultrasound on *Bacillus cereus* bioflms on green leaf surfaces. Bioflms of two *B. cereus* reference strains (ATCC 10987 and ATCC 14579) were grown on spinach, beet and lettuce leaves. Bioflm formation was quantified using crystal violet (CV) assays and cell enumeration. Established bioflms were treated with SAEW with heat (60 °C) and ultrasound and the surviving populations were measured. Obtained inactivation kinetics data was determined by Weibull model. Based on the CV assay, both strains formed bioflms on leaves. During disinfection, SAEW with 80 mg/L treatment for 15 min resulted in a reduction of ~3.0 and ~3.4 log CFU/cm2 for ATCC 10987 and ATCC 14579, respectively. A combination of SAEW with mild heat and ultrasound showed additional reductions for both of the strains and the *TR* (4 log/cm2 reduction) values ± 10.32 min were obtained for the ATCC 10987 bioflms. These data suggest that SAEW with ultrasound and mild heat may provide better cleaning strategies to remove *B. cereus* bioflms from green leaves.

1.2 Effects of ascorbic acid and gamma radiation on shelf life extension of freshwater hilsa, *Tenualosa ilisha* (Hamilton, 1822) at refrigerated temperature

M. M. Ayubi, I. Ara, R. Huque, A. Khatun, M. Islam, M A. Hossain and A. Hossain

This research work has been conducted to evaluate the effect of gamma radiation and ascorbic acid on organoleptic, biochemical and microbial quality to extend shelf life of freshwater hilsa. Organoleptic

evaluation showed that ascorbic acid (1% and 2%) treated and irradiated (1.5 and 3 kGy) samples remained acceptable up to 19 and 21 days, respectively of storage periods at 4 ºC. Tyrosine and phenolic content of fish flesh increased with the increase of storage periods in all the samples but increment of tyrosine value was somewhat lower in irradiated sample compare to control. However, the increasing trend of thiobarbituric acid reactive substance (TBARS) value of fish flesh was higher in both treated samples compared than control. Microbial assessment showed the better result in irradiated (3 kGy) sample compared to other and remained within the safe limit.

1.3 Morphometric, meristic and proximate composition between freshwater and marine hilsa fish

I. Ara, M. M. Ayubi, R. Huque, A. Khatun, M. Islam and M. A. Hossain

The present study was carried out to compare the morphometric, meristic and proximate composition of freshwater and marine hilsa fish. Morphometric characteristics showed higher value in marine hilsa than freshwater. Among them, total length (TL), standard length (SL) and head length (HL) of both varieties showed difference. Body proportions of both hilsa fish, were different. Number of pectorals, pelvic, anal fin rays showed different. Proximate data showed that, freshwater hilsa contained higher moisture content (70 ± 0.34 %) than marine hilsa. Protein (20.06 ± 0.94 %), lipid (13.8 ± 2 %) and ash contents (1.26 ± 0.15 %) were relatively higher in marine hilsa. Freshwater hilsa showed large amount of calcium (182.4 ± 3.48 mg/100 g) and phosphorus (133 ± 4.52 mg/100g) but iron content (3.30 mg/100 g) was higher in marine hilsa. The present result revealed that both marine and freshwater hilsa are nutritionally enriched. Hilsa of freshwater origin is tastier than those of the sea. That is why fresh water hilsa is more popular in Bangladesh.

1.4 Effect of gamma radiation and potassium sorbate on sensory evaluation, chemical and microbial analysis of poa (*Pama pama*) preserved at low temperature

M. S. Islam, M. K. Munshi, R. Huque, A. Hossain, A. Khatun, M. Islam, M. M. Rahman and M. S. I. han.

The study was carried out to evaluate the effectiveness of gamma radiation (1.0 and 1.5 kGy) and 2% potassium sorbate (dipped in 30 and 60 seconds) at low temperature (±4°C) on sensory quality, biochemical composition, microbial load and shelf-life of poa (Pama pama)**.** The organoleptic scores gradually decreased with the progress of storage time. Irradiated and potassium sorbate (2%) treated samples showed the highest acceptable score (5) up to 28 and 21 days respectively. Tyrosine value was lower in irradiated (1.5 KGy) sample than potassium sorbate (2%) treated sample and significantly lower than control. The highest total bacterial count was observed 9.4×10^7 cfu/g (14^{th} day) in control sample. The highest total coliform and Staphylococcus species count was 3.2×10^4 cfu/g (14^{th} day) and 4.15×10^4 cfu/g (0^{th} day) respectively in control sample. Bacteria were identified based on their cultural and biochemical characters. Lactococcus lactis, Klebsiella, E. coli and Enterobacter were sensitive to all the tested 10 antibiotics except erhromycin and penicillin. All were highly sensitive to ciprofloxacin and chloramphenicol and resistant to erhromycin and penicillin. B.cereus, Stephylococcus, Pseudomonas, Micrococcus and P. aeruginosa were resistant except Stephylococcu**s** to gentamicin and imipenem. Study of antibiogram revealed multi-drug resistance of some of the isolates. Combination with irradiation (1.5 KGy) and low temperature (±4ºC) could be most effective treatment in extending shelf-life and overall reductions in microbial load of poa**.**

1.5 Microbial features and qualitative detection of adulteration along with physicochemical characteristics of sweetened yoghurt

M. A. Rahman, A. Hossain, M. Islam, M. S. Hussain and R. Huque

Food adulteration is of major public health concern worldwide. The food safety situation in Bangladesh is at an alarming stage due to food adulteration, microbiological contamination and fraudulence. Milk and milk products are being currently adulterated by substituting ingredients with cheaper materials. The aim of this study was the qualitative detection of adulterants along with physico-chemical and microbial features of sweetened yoghurt. Acidity content of all sweetened yoghurt was found to be ranges from 0.66 ±.05% to 0.77±0.05 which was lower than the standard level of (0.8 to1.2). In both cases (Commercial) branded and (Local) unbranded yoghurt had lower moisture content and higher total solid content compared to standard level (13.5%). Those measurements indicated that sweetened yoghurt samples were adulterated with starch. Meanwhile, both branded and unbranded sweetened yoghurt samples had fat contents ranging between 1.56 ± 0.09% to 2.63 ±0.2% which were below the standard level (3%). On the other hand, protein content ranged

between 3.71±0.02% to 4.33±0.15%, which was higher than standard level of 3.2%. These results revealed that all sweetened yoghurt samples were highly adulterated with urea, starch and ammonium sulphate. From the microbiological point of view, all sweetened yoghurt samples had good quality. For instance, *L. bulgaricus* and *S. thermophilus* were found to be under acceptable range and there were no pathogenic coliform bacteria were found in any of the samples

2. Manpower Development and Training Program

Title of the event	Date	Place	No. of participant
Scientific visit on basic molecular techniques for food safety (TC project (BGD 5032))	24 Jun. - 05 Jul. 2019	Montpellier, France	2
IAEA/RCA Regional training course on the fundamentals of using nuclear techniques for verifying food authenticity (Part II) (RAS 5081)	23-27 Sept. 2019	Beijing, China	2
Training Course on the use of stable isotope techniques to determine food origin and verify food authenticity	7-18 Oct. 2019	IAEA Laboratory, Seibersdorf, Austria	1

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

Title of the event	Organizer	Date	Place
Mid-term Project Review Meeting (RAS 5081)	IAEA	18 -22 Nov. 2019	Hanoi, Vietnam

4. Collaboration Work(s)

- IAEA RCA project, Code: RAS 5081, entitled Enhancing food safety and supporting regional authentication of food staff through implementation of nuclear techniques
- IAEA TC project, Code: BGD 5032, entitled Building capacity in improving food safety using nuclear and other complementary analytical techniques.

Gamma Source Division, IFRB

Objective/Introduction

Gamma Source Division (GSD) of Institute of Food and Radiation Biology (IFRB) has been rendering irradiation services since 1980 to different institutes/ organizations and private companies using Co^{60} panoramic gamma irradiator. GSD is the pioneer irradiation service provider in Bangladesh. Its main objective is to develop and utilize gamma irradiation techniques in research and commercial sectors for better quality products. GSD has provided irradiation services for research purpose to different government (including institutes of BAEC) and private organizations at free of cost during this time period. During this time period, GSD has served irradiation to commercial products of 10 food industries and 31 medical and pharmaceutical companies of Bangladesh and earned 20,33,754/- revenue for the country. During this reporting period, the activities of the source were 48.21 kCi on 1st Jul. 2019 and 42.21 kCi on 30th Jun. 2020. At the same time, the dose rates were 1.99 kGy/hr on 1st Jul. 2019 and 1.69 kGy/hr on 30th Jun. 2020.

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), ZAP Natural Ltd., Apex Pharma Ltd., Brack university, Rajshahi University, Bangladesh University of Science and Technology (BUET) at free of cost during this time period. GSD provides irradiation service for research purpose to 458 food samples (Spirulina, fried rice, pasta, seeds, cheese, fish etc.) and 3406 medical and pharmaceutical samples (bone graft, bone chips, amnion graft, skull, hydrogel, massive bone, rubber stopper etc.).

2. Manpower Development and Training Program

Title	Date	Place	No. of participant
Safety features of Co-60 gamma irradiator	10 Dec. 2019	GSD, IFRB	08
Proper use of TLD, survey meter and pocket dosimeter for personal protection	17 Dec. 2019	GSD, IFRB	08
Utilization of Co-60 Gamma Source in GSD Radiation monitoring program and Documentation procedure of yearly Co-60 Gamma Source License renewal	24 Dec. 2019	GSD, IFRB	08
Food Irradiation and effects of radiation on food Emergency Response plan of GSD	07 Jan. 2020	GSD, IFRB	06
Possible radiation hazards in GSD	14 Feb. 2020	GSD, IFRB	07
Area Radiation Monitoring of GSD	21 Jan. 2020	GSD, IFRB	08
Health surveillance program of the radiation worker	04 Feb. 2020	GSD, IFRB	07
Record keeping in GSD	11 Feb. 2020	GSD, IFRB	08
Transportation of radioactive source	18 Feb. 2020	GSD, IFRB	08
Proper use of Potentiometer for Ceric-Cerous dosimetry	24 Feb. 2020	GSD, IFRB	07
Safety features of Co-60 gamma irradiator	03 Mar. 2020	GSD, IFRB	06
Proper use of UV spectrophotometer for Fricke dosimetry	19 Feb. 2020	GSD, IFRB	06
Proper use of TLD and survey meter, pocket dosimeter for personal protection	17 Mar. 2020	GSD, IFRB	05

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

Name of the participant	Title of the event	Organizer	Date	Place
M. Khan	Radiation Hazard	Communicable Disease Control Division (CDC), Ministry of Health and Family Welfare (MoHF)	5-6 Aug. 2019	Health Institutes, Mohakhali
	E-Nothi Training Program	ICS, AERE	9-13 Oct. 2019	ICS, AERE

4. Service Rendered and Revenue Income

No. of organization	Nature of sample/service	No./quantity of sample	Income
10	Food Irradiation	11.189 Ton	405829/-
31	Medical and Pharmaceutical Products Irradiation	2808 cft	1550400/-
		15505 pcs Shell Dressing	77525/-
Total			2033754/-

Insect Biotechnology Division, IFRB

Objective/Introduction

This division is engaged in developing the methods of management of insect pests and Phytosanitary treatment using nuclear, microbial and biotechnological approaches.

Activities

1. Research and Development Work(s)

1.1 Preliminary survey of dacine fruit flies (Diptera: Tephritidae: Dacinae) in three protected forest areas of Bangladesh

M. A. Hossain, K. Seheli, M. A. Bari, M. Momen, N. Sultana, M. F. Hossain and A. Ghosh

Survey of dacine fruit flies in three protected forest areas of Bangladesh was conducted in 2019. Hawaii traps baited with the fruit fly lures *viz*., cue-lure, methyl eugenol and zingerone were used to trap the dacine fruit flies. To protect decomposition of the fruit flies 2 ml of 25% propylene glycol was used inside each trap. Plastic roof tops were used to protect the traps from rainfall. Traps were maintained every 100 meters along transects covering 180 collection sites among three districts *viz*., Rangamati hill district (Kaptai National park 60 sites), Khagrachari hill districts (Alutila and Panchari forest 60 sites) and Dinajpur district (Dharmapur forest and Singra National Park 60 sites). Most of these sites were located in well preserved and very rich forest. A total of 68,751 flies were collected, (18,557 specimens in cue-lure, 49,768 in methyl eugenol, 426 in zingerone) and were preserved in 95% ethanol. Collected specimens were carried to insect Biotechnology Division, IFRB, AERE for identification. Identification of fruit flies was performed by using the keys of Drew and Romig (2013). It was observed that four species, *viz*., *Bactrocera dorsalis, B. ribigina*, *Zeugodacus tau* and *Z. cucurbitae* are comparatively abundant in these forested areas. The total number of fruit fly species of Rangamati hill district, Khagrachari hill district and Dinajpur district were 18, 14 and 11 species respectively. The present survey results showed that the highest species diversity of fruit fly was found in Rangamati hill district and the lowest was in Dinajpur district. Extensive fruit flies survey should be done in remaining protected forest areas of Bangladesh to prepare a complete checklist of fruit fly fauna.

1.2 Bio-efficacy of indigenous *Bacillus thuringiensis* strains against Melon Fly, *Zeugodacus cucurbitae* (Diptera: Tephritidae)

M. A. Bari, K. Seheli, M. A. Hossain, M. Momen, N. Sultana, M. F. Hossain and A. Ghosh

Zeugodacus cucurbitae (Coq.) (Diptera: Tephritidae) is commonly known as melon fly, one of the most economically important pest species in the world, attacking a wide range of fruits and vegetables throughout tropical and sub-tropical areas including Bangladesh. For a sustainable development of *Bacillus thuringiensis* (*Bt*) based biopesticide susceptible to *Cry* proteins, against *Z. cucurbitae* 20 *Bt* strains harboring different *cry* genes were assayed *in vivo* against the 3rd instar larvae of *Z. cucurbitae* following enhanced expression of *Cry* proteins in T_3 broth. Among the tested twenty indigenous *Bt* strains, seven indigenous *Bt* strains were effective against the 3rd instar larvae of *Z. cucurbitae* and cause more than 50% mortality. Within this seven effective indigenous *Bt* strains *Bt* SaS6 exhibits highest larval mortality 85% with lowest LC_{50} (0.553) value. Other effective indigenous *Bt* strains exhibited more than 50% larval mortality against *Z. cucurbitae* were *Bt* RaSa2 (75%), *Bt* TaSa4 (73%), *Bt* SaS7/19s (63%), *Bt* SSe2 (62%), *Bt* Soi1/li (60%) and *Bt* SaS4 (57%) with lower LC_{50} values 0.676, 0.704, 0.846, 0.882 0.884 and 0.937 ml/gm respectively. Based on the Lethal concentration (LC_{50}) (Logarithmic value of spore count) as estimated by Probit analysis, the efficacy of the strains was compared. The 3rd instar larvae of *Z. cucurbitae* were very susceptible to *Bt* SaS6 with 85% mortality and 0.553 ml/gm LC_{50} value.

1.3 Comparative study on using different types of paper sheets for egg collection from mass reared Colony of *Aedes aegypti*

M. Momen, A. Ghosh, M. F. Hossain, K. Seheli, M. A. Hossain and M. A. Bari

Optimization of a proper mass rearing protocol for *Aedes aegypti* is a pre-requisite for application of the Sterile Insect Technique (SIT). In this context egg collection in an appropriate way from the mass reared colony is a crucial part of the study thus needs to be optimized. Seed Germination paper is a special type of paper used as a substratum in the seed germination test. In this experiment, they were used for egg collection purpose to test their efficiency in contrast to the normal paper. These papers were chosen because of some beneficial properties, i.e., excellent moisture absorbance capacity, free from microorganisms and evenly finished, chemical free and heat resistance, perfectly creped which restrict the mosquito eggs from being clustered. The seed germination papers are of different formats and in customized shapes and sizes for testing seeds. Four different types (i.e., 61MM, 75GP, 125GP, 62CC) along with normal and laboratory filter paper

were used in this study. The egg laying preference of female mosquito has been evaluated by counting the total number of eggs found in each paper sheets in a given time. The preliminary findings showed, germination papers are convenient to use in comparison to the normal paper and filter paper because of their creped structure and wet strength, while 75GP was much preferred with the maximum number of eggs laid by female *Ae aegypti* mosquito. For getting better results in future experiments, these germination papers can be considered as substrate for egg collection purpose in place of normal white papers.

1.4 Molecular identification of dacine fruit fly pest (Diptera: Tephritididae) through the DNA Barcoding of *COI* gene

N. Sultana, K. Seheli, M. A. Hossain, M. A. Bari and M. Momen

Fruit flies (Diptera: Tephritidae) are the most devastating insect pests of agricultural crops throughout the world as well as in Bangladesh. For a successful control measure of this pest, proper and quick identification is necessary, where a molecular technique, DNA barcoding by using mitochondrial Cytochrome Oxidase C Subunit 1 (*COI*) gene could be a good measure. In this context, this study was undertaken to accurately identify the fruit fly species by using the DNA barcoding technique of *COI* gene and represent the phylogenetic relationship of fruit flies. Fruit fly samples were collected by using Cue-lure and Methyl eugenol baited traps and transferred into glass vials containing 95% ethanol. Whole insect was used for extraction of genomic DNA using Qiagen DNeasy® Blood and Tissue Kit. The extracted DNAs were subjected to PCR amplification of a 658 bp region of the *COI* gene following standard PCR protocols. Extracted amplified COI genes were bidirectionally sequenced and identified by NCBI BLAST. Nucleotide sequences were aligned and determined phylogenetic relationship through MEGA version 6. The phylogenetic analysis illustrated low genetic distance among these species while *Bactrocera dorsalis* presented significant genetic divergence. These results could reinforce the effectiveness of DNA barcoding as a tool for monitoring their diversity and for the identification of the species as well as phylogenic evolutionary analysis. Taken together, the correct identification using *COI* gene of these fruit flies may be important for its future use in any areas of research interest including a successful implementation of Sterile Insect Technique (SIT) in Bangladesh.

1.5 Preliminary study on establishment of *Aedes albopictus* (Skuse, 1894) colonies in laboratory

M. Momen, M. F. Hossain, A. Ghosh, M. A. Hossain, M. A. Bari and K. Seheli

Aedes albopictus (Skuse, 1894) is the secondary dengue vector in Bangladesh. According to one-year (from Jan. 2019 to Mar. 2020) surveillance data, the dominant (above 95%) dengue vector was *Ae. albopictus* in AERE campus. So, researches on innovative and conventional *Ae. albopictus* control methods are essential. However, these approaches need laboratory trials and artificial rearing of vectors on a mass scale. Before establishing a colony in the laboratory, desired *Aedes* material was collected from the field. The selection of the artificial membrane feeding technique is recognized as one of the key considerations in the mass rearing of *Ae albopictus*. In the preliminary study, artificial membrane technique was developed to establish a laboratory colony of *Ae. albopictus*. At the larval stage fish feed was used as a diet for the rearing of this mosquito and study shows that it took approximately 7-10 days to complete larva to pupa development. Sugar solution at 10% concentration was supplied to the adult *Ae. albopictus* as carbohydrate source. Further study is required to develop a comprehensive mass rearing protocol for *Ae. albopictus*.

1.6 Effect of gamma irradiation on flight ability and longevity of yellow fever mosquito *Aedes aegypti* in sterile insect technique program

M. F. Hossain, A. Ghosh, K. Seheli, M. Momen, N. Sultana, M. A. Hossain and M. A. Bari

The sterile insect technique has been considered as a potential, eco-friendly and effective technique to control *Aedes aegypti* mosquito. The efficiency of SIT against disease vectors, particularly mosquitoes, depends on the efficiency of irradiated sterile males to induce sterility in the target populations. Flight ability and longevity of mosquito are two prime factors for their dispersal. The purpose of this study was to assess the effect of different doses of radiation on two quality parameters e.g. the flight ability and longevity of sterile male. The preliminary findings revealed that irradiation had some effects on the flight ability of this mosquito. The experiment was conducted to 60 Gy, 70 Gy, 80 Gy, 90 Gy and 100 Gy irradiation doses along with a control batch and the percentages of fliers (those who could fly out of a test device) were found 91.33%, 95.33%, 86.0%, 66.0%, 46.67% and 96.67% respectively. The adult male survival time of the species was reduced by irradiation in a dose-dependent manner, the longevities were found 38.567, 37.133, 35.467,

25.467, 25.4 and 47.033 days for 60 Gy, 70 Gy, 80 Gy, 90 Gy, 100 Gy and 0 Gy respectively. The results of the present study will be helpful in the application of the environment-friendly technique at the semi-field and field level in Bangladesh.

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

Name of the participant	Title of the event	Organizer	Date	Place
Dr. M. Khan and Dr. K. Seheli	Extended Core Committee meeting for International Health Regulation (lHR-2005) focusing on Radiation Hazard	Communicable Disease Control Division, DGHS	5-6 Aug. 2019	DGHS, Mohakhali, Dhaka
M. Momen	Advanced Training on Biotechnology	NIB	23 Sept.-02 Oct. 2019	NIB, Savar
Dr. M. A. Hossain	E-nothi training Program	BAEC	13-16 Oct. 2019	ICS, AERE
N. Sultana	MEXT Program FY2019 on Development and verification of bioproducts as radioprotectant agents and mitigators	MEXT, Japan	15 Oct. 2019-13 Mar. 2020	NIRS, QST, Chiba, Japan
Dr. M. Khan, Dr. K. Seheli, M. A. Bari and M. Momen	2nd National Biotechnology Fair - 2019 (The Team IFRB won 'one of the best stall award')	MoST & NIB	18-19 Oct. 2019	BSMR Novo Theatre, Dhaka
M. A. Bari	PPR-2008 and Public Procurement	BAEC	20-31 Oct. 2019	TI, AERE
Dr. M. A. Hossain and M. Momen	Regional training course on mass rearing, irradiation and release of sterile male *Aedes* species	IAEA	02-06 Dec. 2019	EHA, NEA, Singapore
Dr. M. Khan, M. A. Bari, M. F. Hossain and A. Ghosh	21st International Biennial Conference & AGM on "Conservation of Wetland Biodiversity in Bangladesh	Zoological Society of Bangladesh	7-8 Dec. 2019	Dept. of Zoology, DU
M. Momen and A. Ghosh	Amar Ekushe Grantha Mela-2020	Bangla Academy	4 and 25 Feb. 2020	Bangla Academy, Dhaka
Dr. M. Khan, Dr. Seheli, Dr. M. A. Hossain, M. Momen and N. Sultana	Expert Mission on assessment the feasibility of using SIT for the control of *Aedes* Mosquitoes	BAEC	22 Aug. 2019	INST, AERE

3. Collaboration Work

- IAEA Coordinated Research Program CRP No. 23909 (2020-2025) titled 'Optimization of ɤ-Irradiation Process for Mass Sterilization and the Quality Assurance of Sterile *Aedes aegypti* for Field Release Program'
- FAO/IAEA Coordinated Research Program CRP No. 23135/RO(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'
- IAEA RCA Project No. RAS/5082 (2017-2021) titled 'Managing and Controlling *Aedes* Vector Populations Using the Sterile Insect Technique'
- Collaborative research (Apr. 2013 to date) work between IBD, IFRB and Idaho University & Hawaii University at Manoa, USA on 'Species diversity of tephritid fruit flies in Bangladesh'.

4. Other

Reviewed paper entitled 'Feeding potentiality of *Coccinella septempunctata* on three aphid species and its molecular characterization based on *COI* gene sequence', Dr. K Seheli., Nuclear Science and Application (NSA), Vol 28 (2020).

Microbiology and Industrial Irradiation Division, IFRB

Objective/Introduction

This division is one of the pioneer divisions of IFRB. The division deals with microorganisms those are 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 Incorporation of antimicrobial activity in PVA hydrogel upon addition of chitosan

M. K. Pramanik, M. A. K. Sarker, S. Sultana and M. S. Rahaman

Hydrogel made of polyvinyl alcohol (PVA) is a material that has potential and different biomedical usages including wound healing and burn dressing. PVA along with other natural polymer (e.g., k-carrageenan) is usually processed by gamma radiation and produces flexible, transparent, mechanically suitable, economical and biocompatible hydrogel. In Bangladesh, hydrogel produced/ processed by ionizing radiation has been used for several years which is made of only PVA or PVA plus k-carrageenan where radiation processing and sterilization is performed simultaneously. As chitosan is a natural polymer and its antimicrobial activities can be obtained or enhanced by applying gamma radiation, an effort was made to incorporate chitosan in PVA to attribute the gel with antimicrobial properties upon irradiation by gamma ray from Co-60 source. In this experiment 2.0% and 1.0% chitosan dissolved in 2.0% and 1.0% acetic acid was mixed with same amount of 20% PVA dissolved in distilled water to produce mixture of 1.0% and 0.5% chitosan in 10% PVA, respectively. After casting, this material was irradiated with a radiation dose of 25.0 kGy from Cobalt-60 gamma source. Then, gel disk was made with sterile borer and tested for antimicrobial activity against both Gram positive (*Staphylococcusaureus*) and Gram negative (*E. coli*) bacteria by disk diffusion method on Mueller Hinton Agar medium. Result showed that gel containing chitosan showed antimicrobial activity as per concentration dependent manner as measured by zone of inhibition and Gram positive bacteria was found more sensitive than Gram negative bacteria. Beside antimicrobial properties, some of the physical parameters (e.g., swelling ratio, porosity etc.) were also improved in chitosan- incorporated PVA hydrogel. However, further test and trails are required to optimize and confirm the suitability and biocompatibility issue before its final applications.

1.2 Isolation and screening of Poly-β-hydroxybutyrate (PHB) producing bacteria from food-waste 'Whey' vendored in Savar area

T. Mumtaz, S. J. Zisha and A. K. M. R. Alam

Whey is a byproduct of the manufacture of cheese or milk protein called casein. It has several commercial uses. The present study was undertaken to explore the microbial load of the whey and the possible existence of biopolymer (PHB) producing bacteria in this byproduct. Whey samples were collected from different vendors in the locality of Savar, Dhaka. Samples were brought into laboratory and the microbial load was determined by serial dilution technique using nutrient agar medium. The isolates were purified and maintained in nutrient agar slants for further study. Around 30 colonies were preliminary selected from two samples. Bacteria were isolated from commercial whey samples and yeasts were isolated from local whey samples.15 out of 32 isolates exhibited pink fluorescence on mineral medium, indicates PHA production. Among them 8 isolates were bacteria and the remaining were yeasts. Among bacteria and yeast isolates, bacteria were most potential PHA producer than yeast strains.

1.3 Anaerobic digestion of kitchen waste generated from Atomic Energy Research Establishment (AERE) Cafeteria, Savar for lactic acid production

T. Mumtaz, S. Islam and F. Hossen

At household level, 5.5 percent food is wasted on daily basis. According to Waste Database of Bangladesh (published by Waste Concern), food and vegetable waste such as kitchen waste comprises about 67.75 percent of urban solid waste. Due to its large volume, the disposal of food waste will be a major problem. Production of Organic acid from kitchen waste via anaerobic digestion can eliminate both waste pollution problem and high cost production of organic acid. Such organic acid can be used in food and beverages, pharmaceuticals, cosmetics and detergent industries. The present study was undertaken to convert kitchen waste generated from cafeteria of Atomic Energy Research Establishment (AERE), Savar, Dhaka into lactic acid using natural microflora. The pH range of the kitchen waste was 5.07-6.02. The number of indigenous microflora were found to be 1.25×107 cfu/mL. The gross ratio of rice, meat and vegetables in the kitchen waste was found to be 3:1:1. Kitchen waste was found to contain 19.03% protein, 3.2% fat and 1.5% ash. Anaerobic digestion was carried out in shake flasks at various initial pH (5.0, 6.0 and 7.0) and different temperature (30°C, 37°C and 45°C) for 120 hours. Highest lactic acid from Kitchen waste was produced (24.00 g/L) at 24h at initially adjusted pH-7.0. An attempt to recover Lactic acid from fermented broth was conducted using rotary evaporation at 100°C and at vacuum pressure of 60-65 cm Hg. The results from this study indicated that, the volume of food waste can be greatly reduced and this can be converted into value-added products such as lactic acid via anaerobic fermentation.

1.4 Isolation and characterization of a potential baker's yeast as a leavening agent in bread making

Z. Mahal and M. K. Pramanik

Baker’s yeast *Saccharomyces cerevisiae* is one of the most essential imported ingredients in baking industries/bakery in Bangladesh. So, the present study focused on the isolation and identification of a potential baker's yeast from various indigenous sources as a leavening agent in bread making. Different locally available decomposed fruits e.g. banana, jackfruit and mango were used to isolate yeasts based on the standard cultural, morphological and biochemical characteristics to observe their role as the alternative sources of yeast in industry. Therefore, different biochemical tests, e. g., sugar fermentation capacity test, ethanol tolerance test, hydrogen sulfide (H_2S) production test, temperature tolerance test, flocculation test as well as stress exclusion test were conducted. In this study Malt extract Yeast extract Glucose Peptone (MYGP) was used to isolate and identify indigenous yeasts found in different decomposed local fruits. Total eight yeasts were isolated from the three different fruits. Almost all of them showedthetemperature and ethanol tolerance at 37°C and 15% respectively as well as high flocculation ability, exhibited high fermentative capacity and survived when subjected to various stress conditions. The characteristics exhibited by the isolated yeasts are almost same to that of the commercial yeast. Our findings indicate that the local fruits could be a potential source of indigenous yeasts as leavening agent in bread preparation.

1.5 Microbiological and physical properties of pet bottled mineral water of Ganakbari area of Savar, Dhaka

M. A. K. Sarker, A. A. Vuya and M. K. Pramanik

Now-a-days pet bottled mineral water is a good source of drinking water. This water can be sometimes contaminated during the processing, packaging and distribution. Eight pet bottled mineral water from different commercial brands from Ganakbari, Savar area were evaluated for physical and microbiological qualities. Both physical and microbiological properties of these pet bottled mineral water was in acceptance range. All of the pet bottled water contained no visual floating material, sediments. Turbidity and odour were also absent. Rivera contained seven CFU/100 ml of water whereas Aquafina, Kinley and Pran pet bottled water contained two CFU/ 100 ml of water. Rivera and Kinley brand water contained fungus. All of the tested mineral water was free from coliforms and fecal coliforms which indicates high hygienic condition of the mineral water. In spite of presence of some bacterial and fungal count all of the mineral water at Ganakbari area are suitable for drinking and other purposes.

1.6 Identification of Cr (VI) tolerant bacteria and determination of their MTC

M. R. Khan, A. B. Miah, M. A. B. Siddique, R. Khan and M. K. Pramanik

Chromium (Cr), a non-essential, highly-toxic to almost all living entities including microorganisms which is widely used in tannery industry. However, some microbes are able to tolerate high concentration of Cr and

can transform highly-toxic Cr (VI) to less toxic Cr (III). In this study, we identified six Cr (VI) tolerant bacteria that were previously isolated from tannery effluent adulterated river-bed and determined the maximum tolerance concentration (MTC) of identified bacteria to Cr (VI). The bacteria were provisionally identified up to species based on cultural, morphological, physiological and biochemical characteristics. To assess MTC, ten concentrations such as 100, 200, 400, 600, 800, 1000, 1200, 1400, 1600, 1800 and 2000 ppm of $K_2Cr_2O_7$ were used as Cr (VI) source. The identified organisms were *Corynebacterium*bovis (RK1), *Bacillus anthracis* (RK2), *Listeria grayl* (RK3), *Corynebacterium haemolyticum* (RK4), *Kurthia spp.* (RK5) and *Bacillus pantothenticus* (RK6). In MTC study, four isolates such as *Listeria grayl* (RK3), *Corynebacterium haemolyticum* (RK4), *Kurthia spp.* (RK5) and *Bacillus pantothenticus* (RK6) were found tolerant up to 1000 ppm of $K_2Cr_2O_7$. Further study on these bacteria is required as these could be promising in the reduction of chromium present in effluent from industries.

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

Name of the participant	Title of the event	Organizer	Date	Place
Dr. M. K. Pramanik	FNCA-workshop, (Biofertilizer project)	National Nuclear Energy Agency, Center for Isotopes and Radiation Application, Jakarta, Indonesia	03-07 Sept. 2019	Yogyakarta, Indonesia
Dr. T. Mumtaz	First RCA Meeting on Radiation based technologies for treatment of emerging organic pollutants	IAEA	4-8 Nov. 2019	Vienna, Austria
	Global Challenges Research Fund Symposium on The Role of Gender in South Asian Food Systems' As Panelist in Gender Resilience	GCRF,UK	23 - 24 Feb. 2020	Radisson Blu Dhaka Water Garden Hotel, Dhaka
	Celebration of International Women's Day 2020 Engage and Empower Women in STEM Education, Power and Energy Sector Institutions	IEEE, BUET	13 Mar. 2020	BUET
	Attended an online symposium on Expert Opinion on Covid-19 Pandemic Prevention, Treatment and Management	Bangladesh Society of Microbiologists and Dhaka University Microbiology Alumni Association	30 May 2020 (Bangladesh time at 9 pm)	Zoom link https://ufl.zoom.us/j/975512424062
	Attended a webinar on Mental Wellbeing during Covid-19	OWSD Bangladesh National Chapter	3 Jun. (at 8 pm, Bangladesh time)	Zoom link https://bdren.zoom.us/j/62459412539
S. Razia	4th International Conference on Biotechnology in Health and Agriculture	Global Network of Bangladeshi Biotechnologists (GNOBB) jointly with 4th Innovations inPlant and Food Sciences (IPFS)	11-13 Nov. 2019	DU
	33rd Annual Conference of the Bangladesh Society of Microbiologists (BSM)	Jointly organizedby the Dept. of Microbiology, DU and BSM	26 Dec. 2019	DU

3. Collaboration Work(s)

- It has active collaboration with Dhaka University, Jahangirnagar University, Jessore University of Science and Technology, Kushtia Islamic University etc. for academic and research purposes
- This division has a new CRP project on 'Radiation based technologies for treatment of emerging organic pollutants (F23034)" FY 2019-2022.

4. Service Rendered and Revenue Income

No. of organization	Name of sample/service	No. of sample	Income
9	Sample: Food/Feed Service: Microbiological analysis	17	85800/-
3	Sample: Pharmaceutical Service: Microbiological analysis	4	14400/-
Total		21	100200/-

Radiation Entomology and Acarology Division, IFRB

Objective

The R & D activities of Radiation Entomology and Acarology Division focuses on development of Environ.ly safe integrated pest management techniques against agricultural insect pests of economic importance by using gamma radiation, sterile insect technique (SIT), biodegradable botanicals, hormones, pheromones, biological control agents and insecticides and insect pest management by genetic manipulation with emphasis on Genetic Sexing Strain (GSS).

Activities

1. Research and Development Work(s)

1.1 Chilling effect on pupal period extension, adult emergence and flight ability of blow fly, *Luciliacuprina* (Diptera: Calliphoridae)

M. Yasmin, M. S. Islam, M. Hossain and A. T. M. F. Islam

A distressing temperature (4° C) was introduced on 3rd day old blow fly pupae at different interval of24 hr, 30 hr, 48 hr and 72 hr to observe the extension of pupation, percentage of adult emergence and flight ability. In addition, a control batch was placed at a room temperature of 28 ±2°C. A delay of adult emergence for 1 day was noticed at 24 and 30 hr of chilling exposure comparing the control batch. While the pupation extends for 3 days both in case of 48 and 72 hr of chilling. No interruption was found in case of percentage of adult emergence from all those chilling treatment durations. In case of flight ability, only 20.4 ± 0.244 % of adult flies were recognized as flightless at 24 and 30 hr long chilling treatment. From the above-mentioned experiment, it can be concluded that chilling effect at a very low temperature on blow fly pupae at different duration will be a very efficient practice without hampering any morphological and physiological expression of adult fly and thereby, it will lead to a successful field application of blowfly SIT program.

1.2 The reproductive period and productivity of female blow fly,*Luciliacuprina* (Diptera: Calliphoridae) in laboratory condition

M. Yasmin, M. S. Islam, M. Hossain and A. T. M. F. Islam

The aspects of reproductive periods and productivity of female blowfly inlaboratory condition of 28 ±2 ° C and 65 ± 5 % of relative humidity was examined with a view to understand the basics of biological potentiality of a female blowfly fly in a laboratory condition. A total of 2570 eggs were counted from all five pairs of blow flies (male: female, 1: 1). The mean number of eggs per female was exposed as 514 ± 119.36 on an average. It was noted from this trial that a female blow fly can oviposit maximum 6 times till its death. The peak oviposition time laid between 1st and 2nd oviposition period while in progression, the egg laying pattern declined gradually. The pupal weight per oviposition ranged from 0.0006 to 0.0202 gm. The reproductive extent included preoviposition, oviposition and post oviposition period of 5.6 ± 0.509, 9.0 ± 3.08 and 7.0± 2.86 days respectively. The present data from this trial can be utilized in comparing the wild female potentiality which in turn will be convenient for Blow fly Sterile Insect Technique (SIT) program.

1.3 The impact of different artificial diets on developmental growth of mature larvae and pupae of blowfly (*LuciliaCuprina*, Diptera: Calliphoridae)

M. Hossain, M. S. Islam, M. Yasmin and A. T. M. F. Islam

The sterile insect technique (SIT) requires the mass rearing, sterilization and release of large numbers of insects to induce sterility within wild pest populations. Mass rearing of blowfly, *LuciliaCuprina* (Diptera:

Calliphoridae) for SIT on natural diet (fish) is more expensive. So effective low-cost diet is required for mass raring. To get a good quality sterile adult depends on healthy larvae and pupae. The growth of larvae and pupae were observed on three artificial diets (Diet- A: agar, wheat bran, milk powder, chicken egg, bovine blood and water; Diet- B: all ingredients of Diet- A except milk powder; Diet- C: all ingredients of Diet- B except chicken egg). The length of 3rd day larvae (10.8±1.1353 mm) and dropping larvae (9.15±0.7091 mm) were highest in diet-B. The weight of 3rd day larvae (0.0348±0.0028gm) was highest in diet-B but dropping larvae (0.0358±0.0049gm) and 3rd day pupae (0.028±0.003gm) were in die-A. The results indicated that diet-B can be used as mass rearing for low effective cost in further research.

1.4 Biology of the *Podontiaquatuordecimpunctata* L (Coleoptera:Chrysomelidae), a defoliator pest of hogplum in Bangladesh

M. S. Islam, M. Yasmin, M. Hossain and A. T. M. F. Islam

Podontiaquatuordecimpunctata commonly known as a 14-*punctata* hogplum beetle belongs to order Coleoptera under the family Chrysomelidae. In Bangladesh the cultivation of hog-plum is seriously hampered by this beetle. Biology of the hog plum beetle was studied in laboratory condition at mean temperature of 29.02°C (±0.47) with mean relative humidity 62.78% (±5.59). Results revealed that the mean incubation period, larval period, Pre pupal period, Pupal period was 6.16±0.94 days, 14.21±0.66 days, 5.54±0.498 days and 20.92±2.71 days, respectively. The development period from egg to adult emergence took 46.83±7.297 days and the entire life cycle was 89.16±3.179 days and 97.49±2.712 days for male and female respectively. The female beetle lived longer (50.66±9.884 days) than male beetle (42.33±6.596 days). The measurement of the egg, 1st, 2nd, 3rd and 4th instar larvae were 2±0.103mm, 4.29±0.54mm, 8.58±0.52mm 14.50±1.32mm and (20.08±2.15mm) respectively. Before pupation, larvae entered the soil for pupation at the depth of 2 to 3 inches. It made an oval cocoon of particles of earth within which it pupate and the average length of the cocoon was 15.78±1.12 mm.

1.5 Life cycle and population abundance of lime butterfly, *Papiliodemoleus* L. (Papilionidae: Lepidoptera)

M. S. Islam, M. Yasmin, M. Hossain and A. T. M. F. Islam

In Bangladesh, the identity of the *Papiliodemoleus* infesting the important crop plants (citrus species) and causes serious damage by devouring large quantity of foliage by caterpillar. The lime butterfly, *Papiliodemoleus* (Linnaeus) reared in the laboratory on its host plant, citrus (*Citrus limon*) at 28.16°C (±0.32) with mean relative humidity 65.5% (±4.51) during Apr. to Jul. 2019.Based on weight and size measurements, the morphometric variations of different life stages of the *P. demoleus* were recorded. The life cycle was completed in 23.5-29.5 (27.89±2.36) days, with egg hatching 2.5-3.0 (2.91±0.32) days, larvae 12.0-16.5(15.06±0.78) days and pupae 8.0-9.5 (8.88±0.57) days. Adult longevity was 4.13±0.48 days for male and 7.24±0.77 days for female. Adult male wingspan was 89.18±1.69 mm and female wingspan was 90.44±2.21 mm. The pupa of *P. demoleus*was dimorphic with regards to color (green and brown color). Field observation showed bimodal pattern of monthly fluctuation of adult population with two peaks, first one formed in the month of April to May and second one was found in December. The first peak was much higher than second peak.

1.6 C-banding patterns in mitotic metaphase chromosomes of the Peach fruit fly, *Bactrocerazonata* (Diptera: Tephritidae)

F. Yesmin and M. N. Uddin

The Peach fruit fly, *Bactrocerazonata* (Saunders) (Diptera: Tephritidae) is widely spread to South and South-East Asia. Itinfests a large number of fruits including peach (stone fruit), mango, guava, fig, banana, papaya and citrus fruits. The distinctive patterns of constitutive heterochromatin in mitotic metaphase karyotypes of 3rd instar larva are detected by C-banding procedure. It is considered as an important tool for cytogenetic studies of economically important dipteran fly. *B.zonata*contained a diploid number of bi-armed chromosome (2n=12) including one pair of heteromorphic (XX/XY) sex chromosome and five pairs of autosome. A specific heterochromatin distribution patterns with positive C-bands were found in their centromere region in all autosomes. Dot-shaped Y chromosome was observed with full heterochromatic condition and X chromosomes were appeared with one thin telomeric band in the short arm and another deep band in their centromere region. This findings clarify a precise information of individual chromosome of the target pest for elaborate cytogenetic and molecular study.

1.7 Polytene chromosomes of the Pumpkin fruit fly, *Zeugodacus*(*Bactrocera*) *tau* (Walker) (Diptera: Tephritidae)

F. Yesmin and M. N. Uddin

The pumpkin fruit fly, *Zeugodacus* (*Bactrocera*) *tau* (Walker) is a significant agricultural pest of the family Tephritidae. It is widely distributed throughout South East Asian countries including Bangladesh. It infests more than 80 species of fruits and vegetables under 16 families. It has been listed as a quarantine pest in many countries. A photographic arrangement of 3rdinstar larval salivary gland polytene chromosomes of this species have been described that associates individual polytene arms, their identifying tips and most distinguished landmarks. Each polytene nucleus consisted of five banded (polytene) long chromosomes. Longer arm considered as left (L) and the short arm known as right (R) following their centromere position. Chromosomes are number with 2-6 according to descending order while 2 is the longest and 6 is the shortest chromosome in each polytene nucleus. Absence of polytenized sex chromosomes in the polytene nucleus suggested that these five polytene chromosomes correspond to five autosomes in mitotic karyotype. This photographic representation facilitates knowledge to construct salivary gland polytene chromosome maps of this pest species, which is a fundamental tool for the establishment of genetic sexing strain (GSS) of *Z. tau*insterile insect technique (SIT) field application.

1.8 Impact of milk protein additive to adult diet on some biological parameters of the melon fly, *Bactroceracucurbitae* (Diptera: Tephritidae)

T. Hossain and F. Yesmin

The melon fly, *Bactroceracucurbitae*is a very serious pest of fleshy fruits and vegetables in Bangladesh. Damage levels can be reached up to 100% of unguarded cucurbit crops. The impact of milk protein casein hydrolysate as additive to adult diet on some biological parameters of*B.cucurbitae*was studied. The objective of this study was to examine the effects of two artificial adult diets on different biological parameters of *B.cucurbitae*. Experiments were conducted by using same sizes of adult rearing cages fencing with nylon net. Two different diets (Yeast extract: Sugar, 1:3 as $Diet_1$ and Casein hydrolysate: Yeast extract: Sugar, 1:1:3 as $Diet_2$) were served as adult food source and tap water with soaked cotton as water. Sweet gourd was given as egg laying and larval food medium. Mean egg incubation period was 2.33 days in both diets. Larvae and pupae of D_2 took slightly higher duration than D_1. Adult emergence % and male-female ratio indicate a positive correlation to D_1 though a slightly higher population of overall adult and female produced in D_2 in F_1. Pupae and their weight also indicate a better result in D_1. Results showed no significant differences for egg incubation period, larval duration, pupal period, pupae recovery, adult emergence and sex ratio of*B. cucurbitae*, reared on two different adult diets. It indicates that casein hydrolysate as milk protein additive had no remarkable effect on different biological parameters of the melon fly, *B. cucurbitae*. Results revealed that yeast extract and sugar (1:3) diet (D_1) could be used as a regular adult diet for the development of melon fly under laboratory condition.

1.9 The Effect of dietary restriction on survivorship of *Bactroceracucurbitae* (Diptera: Tephritidae)

T. Hossain and F. Yesmin

The effect of dietary restriction on the longevity of virgin males and females of *Bactroceracucurbitae* was investigated. Four groups of flies, each with 25, were fed four separate diets with yeast-to-sugar ratio of 0:100; 1.96: 98.04; 4.76: 95.24; and 25:75 continuously for 45 days from the day of eclosion. The flies were maintained in the laboratory at 28±2ºC temperature and about 75±5% relative humidity throughout the experiment. We recorded that after the study period the survivorship of virgin males feeding on diets containing 0%,1.96%,4.76% and 25% yeast counted down to 10, 18.33, 19 and 11.33, whereas virgin females to 15, 23, 23,33 and 17.66 respectively. Study showed that flies feeding diet containing intermittent yeast, 1.96% and 4.76%, lived longer than diet containing 0% and 25% yeast for both male and female. Study also suggested that virgin females lived significantly longer than its male counterpart on all diets. Study demonstrated intermittent yeast to be ideal food for both flies.

2. Manpower Development and Training Program

Title	Place	No. of participants
In- house training	IFRB, AERE	4

3. Seminar/Symposium/Conference/Workshop Attended

Name of the participant	Title of the event	Organizer	Date	Place
M. Yasmin, M. S. Islam and M. Hossain	21st International Biennial Conference and AGM- 2019 of Zoological Society of Bangladesh	Zoological Society of Bangladesh	07-08 Dec. 2019	DU
A. T. M. F. Islam	Scientific visit on Mass Rearing and Field Release of Sterile Insect Technique	Modernization of Food and Radiation Biology Facilities of BAEC	03 - 17 Jul. 2019	Vienna, Austria
Dr. F. Yesmin	4th Young Scientist Congress (Young scientists for achieving sustainable development goals)	Bangladesh Academy of Sciences (BAS)	13-15 Dec. 2019	NMST Bhaban, Agargaon
	Fruit Fly Chemical Ecology Online Workshop	ARC (Australian Research Council)	4- 25 Jun. 2020	Canberra, Australia
T. Hossain	Advance Training on Biotechnology	National Institute of Biotechnology	2- 11 Mar. 2020	NIB, Savar

4. Collaboration Work(s)

- Between faculty of Science, 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 Environ. adaptation and population management"
- With The World Academy of Science (TWAS) on Cytogenetic analysis of peach fruit fly, *Bactrocerazonata* (Saunders) (Diptera: Tephritidae) in Bangladesh with relation to sterile insect technique (SIT) application.

Veterinary Drug Residue Analysis Division, IFRB

Veterinary drug residue analysis division (VDRAD) deals with the development and application of several nuclear and analytical techniques for screening and confirmatory analysis of different veterinary drug residues and related contaminants in foods of animal origin. Specifically, the aim of this division is to monitor and control of those residues in foods to protect public health and to promote international trade of Bangladeshi food products.

Activities

1. Research and Development Work(s)

- Screening of the presence of antibiotics and mycotoxins in animal origin food samples (fish, meat, milk, eggs, shrimp, etc.) collected from different markets and farms of the country using ELISA, Radio Immunoassay (RIA) and Microbial Inhibition Test (MIT) methods
- Qualitative and quantitative analysis of antibiotics and mycotoxins residues present in animal originated foods (fish, meat, milk, eggs, shrimp, etc.) using chromatographic techniques such as HPLC and state-of-the-art LC-MS/MS System
- Research on the deposition and depletion of antibiotics applied to food-producing animals to facilitate capability of Bangladesh for participating in the Codex standard setting process/program
- Conducting joint research with various regional and international research institutes and/ororganizations for achieving international acceptance on analytical capability
- Routinely participated in the proficiency test (PT) provided by Progetto Trieste, Italyfor reliability of our developed methods validation.

2. Manpower Development and Training Program

Title of the event	Date	Place	No. of participant
In house training carried out on method development and validation procedures to determine antibiotic and mycotoxin residues in animal originated foods (fish, meat, milk, eggs, shrimp, etc.) using CHARM II, ELISA, HPLC and LC-MS/MS systemsprovided	Jul. 2019-Jun. 2020	VDRAD, IFRB	12

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

Name of the participant	Title of the event	Organizer	Date	Place
M. M. B. Prince and D. Chakma	Training on Screening of Veterinary drug residues in foods of animal origin	Govt. of Bangladesh (ADP)	l8 Nov.- 2 Dec. 20l9	Belgium
Dr. M. J. Islam	Regional Training Course on Cost-effective Analysis of Targeted Veterinary Drug Residues and Mycotoxins in Food and Feed	IAEA	26-30 Aug. 2019	Malaysia
Dr. A. S. M. Saifullah	Coordination and review meeting RAS 5078	IAEA	02-06 Sept. 2019	Ulaanbaatar, Mongolia

4. Collaboration Work/MoU

- Project Code: RAS5078, entitled "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, Duration: 2016-2020
- S & T project, entitled "Determination of Aflatoxin M1 Residue in Milk using Nuclear Technique" (Group: ID-462), Principal investigator: Dr. Md. Nazrul Islam, Associate investigator: Dr. A S M Saifullah.

Plant Biotechnology and Genetic Engineering Division, IFRB

Introduction

The country demands more food for 166 million Bangladeshi. In fact, agricultural land is decreasing due to housing, industrialization soil erosion and salinity. Objective of the research to Development of tissue culture techniques for improvement/cloning of economic and endangered plants.Development of mutant with desired characteristics in commercial and economically important crops by using induced mutation and *in vitro* mutagenesis. Establishment and exploitation of genetic transformation techniques in plants of interest to obtain transgenic plantswith desired characteristics.

Activities

1. Research and Development Work(s)

1.1 Improvement of indigenous rice genotypes with higher yield, agronomic traitsand resistant to biotic and abiotic tracesusing gamma and carbon ion beam irradiation in conjunction with*in vitro*techniques and molecular approaches

The continuous increase of population in the country demands more food to grow. It results more land for rice cultivation as rice is the staple food for 167 million people in the country. In fact, land is decreasing due to the housing of increasing population, creation of new industry and soil erosion. Rice plays an absolute dominant role in Bangladesh Agriculture. The rice production and yield are still low in the country comparing to other rice growing countries in the world. The low yield of rice in the country is due to the cultivation of low yield potential genotypes, flash flooding, soil erosion, biotic and abiotic traces as well. Therefore, it is necessary to create new mutant variety with higher yield, improve agronomic traits and tolerant to biotic and abiotic traces in local rice genotypes using mutation breeding in conjunction with *in vitro* techniques and molecular approaches. Indigenous cultivars of rice grown in the coastal/off-shore area of Sonagazi, Satkhira, Bagerhut, Cox's Bazar and Teknuf were collected for the rice improvement program. Seeds of these cultivars were irradiated with different doses (50 to 350 Gy) of gamma irradiation/ carbon ion beam for induction of

mutants. Moreover, *in vitro* raised callus/somatic embryo from rice seeds were irradiated with different doses (5 to 25Gy) of gamma irradiation to observe the useful phenotypic variants. Polymorphisms of different promising advanced mutant lines were studied by comparing banding patterns of the mutants with the parents and it was done using SSR markers.

1.2 Isolation, purification, conservation and superior progeny development of some gerbera (Gerbera spp.) plant species through gamma irradiation and their *in vitro* clonal propagation

Plant tissue culture provides adequate number of pathogen free saplings round the year which is true to parental type but it is not ensures varietal difference. Improved varieties development is crucial in context to climatic changes in the country. It can be performed using chemical mutagen as well as different types of irradiator. In the present investigation efforts were made to develop advance and improved mutant varieties of Gerbera using cobalt-60 gamma irradiator. Radiation has been shown to be an effective physical agent for inducing mutation. In the recent years scientists around the world were successful to developed new improved plant varieties which are resistant to different biotic and abiotic factors.

High frequency calli induction were obtained from young capitulum of Gerbera (*Gerbera spp.*) by culturing onto MS medium supplemented either with 1.5 mg^{-l} each of BAP + 2,4-D or Kn + 2,4-D. Some shoots were regenerated during sub-culturing of these calli on the same medium. Shoot tip and leaf petiole of the regenerated shoots thus obtained were further used as explants for multiple shoot induction. Best response towards multiple shoot induction was noticed from both shoot tip and leaf petiole when cultured onto MS medium containing 2.0 mg^{-l} BAP + 1.0 mg^{-l} IAA. An average of 20 and 16 shoot buds were obtained from leaf petiole and shoot tips respectively. The number of shoot buds increased vigorously during sub-culturing on the same medium. In the present study different explants of gerbera were irradiated with five level of dose from 20 to 60 Gy of a cobalt-60 gamma source at a dose rate of 20 Gy/min. Radiation sensitivity and post irradiation recovery were assessed by measuring survival rate, propagation rate, shoot height and fresh weight. The time at which the cells are irradiated is very critical. The optimal timing for irradiation is considered to be 4-6 days after subculture because at this time the majority of cells are in the G1 phase. One of the most important steps in mutagenesis experiments is to determine the appropriate dose. Theoretically, LD-50 would cause the highest frequency of mutations. In the present investigation LD-50 were determined for each of the four mentioned gerbera plant varieties. 40 to 50 Gy were effective for all varieties. For *in vitro* rooting of regenerated shoots, half strength MS medium added with different concentrations of IAA and IBA were used. Best root development was found in 1.0mg^{-l} IBA supplemented half strength MS medium. About 85% of the regenerated plantlets were survived in natural conditions.

2. Manpower Development and Training Program

Title of the event	Date	Place	No. of participant
In-house training course on office manners and general behavior -II	6-7 Dec. 2019	TI, AERE	56

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

Name of the participant	Title of the event	Organizer	Date	Place
Dr. A. N. K. Mamun, M. R. Islam, M. T. Jahan, M. M. Islam and S. A. M. S. Islam	9th International Plant Tissue Culture and Biotechnology Conference on Biotechnology for Food Security and Sustainable Environment	BAPTC&B	8-10 Feb. 2020	DU

4. Collaboration Work(s)

MoU were made among BAEC and Lal Teer Seed Ltd., Bangladesh and also Takasaki Advanced Radiation Research Institute, QST, Japan. The objectives are to facilitate R&D activities including mutation breeding program with a view to develop new mutant varieties with higher yield, improved agronomic traits and adaptable to climate change.

- IAEA/RCA Project, entitled "Complementation Conventional Approaches with Nuclear Techniques towards Flood Risk and post-Flood Rehabilitation Efforts in Asia" RAS5069, to develop salt tolerant rice variety for the coastal/off-shore saline andflood affected areas of Bangladesh

- IAEA/RCA Project, entitled "Promoting the Application of Mutation Technique and Related Biotechnologies for the Development of Green Crop Variety" RAS5077, to develop high yielding/salt tolerant/improved agronomic traits of rice using mutation techniques and biotechnology
- IAEA/TC-Project, entitled "Strengthening capacity in the maintenance and utilization of the Tandem Accelerator Facility" IAEA/TC-BGD0010, to design the mutation breeding facility
- Forum for Nuclear Cooperation in Asia (FNCA) on Mutation Breeding Project, to develop improved rice variety with higher yield and biotic & abiotic stresstolerant.

INSTITUTE OF TISSUE BANKING AND BIOMATERIAL RESEARCH (ITBBR), AERE

Introduction

ITBBR owns the only human tissue bank in Bangladesh. Many types of hard and soft tissue allografts and autografts are being processed, radiation sterilized, quality controlled and supplied to the hospitals and clinics in our country. Generally, the supplied tissue grafts are regularly used in rehabilitative surgeries of Orthopedics, Spinal, Oral and Maxillofacial, Neurosurgery; Burn & Plastic surgery and also in Ophthalmology. Research and development activities are regularly being carried out by ITBBR scientits. Work on tissue engineering, human cell culture, burn and wound gel preparation and on grafts sterilization are presently focused in ITBBR.

Activities

1. Research and Development Work(s)

- Bioburden determination, sterility assurance and quality control of lyophilised cancellous bone allografts, deep-frozen massive bone allografts, oven-dried amniotic membrane allografts etc.
- Fabrication of nano-particle incorporated hydroxyapatite scaffold composites for bone tissue engineering
- Synthesis of amniotic-hydrogel for in vivo burn wound healing
- Work on biomolecules and mammalian cells.

2. Manpower Development and Training Program

Title of the event	Date	Place	No. of participants
Antihypertensive effect of synthetic dipeptide, try-pro(YP), stroke-prone spontaneously hypertensive rats, SHRSP	03 Feb. 2020	ITBBR, AERE	50

3. Seminar/Symposium/Conference/Meeting Attended

Name of the participant	Title of the event	Organizer	Date	Place
Dr. M. Arifuzzaman, T. A. Arafat and P. C. Karmakar	Annual conference of Bangladesh Orthopaedic Society (BOSCON)-2020	Bangladesh Orthopaedic Society	03-05 Feb. 2020	NITOR, Dhaka

4. Collaboration Work

Ministry of Science and Technology Project, entitled "Isolation and characterization of adipose tissue derived stem cells originated from the model animal", 2019-2020.

5. Service Rendered and Revenue Income

Nature/name of service	No. of sample	Income
Supply of bone tissue allogtafts	14302	787380/-
Supply of amniotic membrane allografts	6020	
Total	20322	787680/-

NATIONAL INSTITUTE OF NUCLEAR MEDICINE & ALLIED SCIENCES (NINMAS), SHAHBAG

National Institute of Nuclear Medicine & Allied Sciences (NINMAS) is the apex Nuclear Medicine facility in Bangladesh and it is located in Bangabandhu Sheikh Mujib Medical University (BSMMU) premise. The Institutes provides medical imaging using nuclear techniques and therapeutic treatment services.

Objectives

- To render specialized medical services to the people using nuclear technology
- To improve and upgrade Nuclear Medicine facilities in Bangladesh
- To conduct training of physicians, physicists, radiopharmacists and technologists in the field of nuclear medicine
- To conduct academic and research activities
- To coordinate and standardize the activities of all nuclear medicine establishments of BAEC.

Activities

1. Clinical Services

1.1 Diagnostic

- The Institute is equipped with 2 PET-CT facilities. PET-CT scan is very useful for early diagnosis and staging of cancer for the people of Bangladesh
- The institute is equipped with three SPECT, one SPECT-CT and one planar Gamma camera. The Scintigraphic studies are: Bone scan, Brain scan, Kidney (DTPA, DMSA), GFR, Hepatobiliary, HIDA, Lymphoscintigraphy, GI bleeding, Thyroid Scan, parathyroid, Salivary, Cardiac and Testicles, Lung Perfusion etc.
- Thyroid Imaging and Uptake
- BMD (Bone Mineral Densitometry) for early detection of osteoporosis/osteopenia
- 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 vascular system are routinely performed
- Hormone Analysis: By using the RIA and modern CLIA techniques the In-vitro division is estimating all thyroids related hormones like T3, T4, TSH, FT3, FT4, LH, FSH, pituitary hormones, estrogen, progesterone, prolactin, testosterone, follicular stimulating and luteinizing hormones, Vitamin D, parathormone and Tumor Marker: Thyroglobulin, etc.
- Screening of Congenital Hypothyroidism in Newborn Babies: In-vitro Division is also playing an important role in the screening of Congenital Hypothyroidism by Newborn Screening with the aid of Dissociation Enhanced Lanthanide Fluorescence Immunoassay (DELFIA) technique in Dried Blood Spot (DBS) method; implementation of the ADP Project "Screening of Congenital Hypothyroidism in Newborn Babies (Phase 2).

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
- I-131 labeled MIBG for diagnosis and therapy of neuroendocrine tumors.

2. Academic

- NINMAS is the only institute in the country where postgraduate degrees like MD (Nuclear Medicine) course which have been conducted for the medical graduates under Bangabandhu Sheikh Mujib Medical University (BSMMU). In last academic session, twelve residents were admitted for MD course of 5 years duration

- One Physician from abroad has been doing his MD (Nuclear Medicine) after completion his IAEA fellowship training in NINMAS
- Weekly journal review as 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
- Jointly organized in collaboration with KOICA and SNUH team weekly on "Summer TEIN Workshop, 2019" from 8th Jul. to 26th Aug., 2019 on different topics of Nuclear Medicine (Radiopharmaceutical: production and quality control, Deep Learning in Medical Imaging I, Radiopharmaceutical: Cyclotron based, Deep Learning in Medical Imaging III, DEEP Learning - Data & amp; AI for Nuclear Medicine, GMP and Quality Control of Radiopharmaceuticals; total seven topics)
- Jointly organized in collaboration with KOICA and SNUH team weekly on "Winter TEIN Workshop, 2020" from 6th Jan. to 25th Feb., 2020 on different topics of Nuclear Medicine (Gamma Camera, SPECT, PET, Image analysis, Image quality, Internal dosimetry, Gamma camera and SPECT quality control, PET quality control; total eight topics).

3. Training/Workshop/Seminar/Conferences Arranged

Title of the event	Organizer	Date	Place	No. of participants
In house training on Covid Awareness, Do's and Don'ts in Our Premises	NINMAS, Dhaka	02 -11 Jun. 2020	NINMAS, Dhaka	70
In-house training on decorum of nuclear medicine technologist on Covid-19 situation as Corona Preparedness protocol	NINMAS, Dhaka	02 -11 Jun. 2020	NINMAS, Dhaka	40
In-house training on decorum of office staff on Covid-19 situation as Corona Preparedness protocol	NINMAS, Dhaka	16 Mar. 2020	NINMAS, Dhaka	70
Seminar on Updates in Nuclear Medicine and Screening of Congenital Hypothyroidism in New Born Babies	*ADP Project	24 Feb. 2020	Sher-e-Bangla Medical College & Hospital Campus, Barisal	400
Training on HIS, RIS & PACS IT Technology for data/image transfer and manipulation at NINMAS	NINMAS, Dhaka	10-12 Dec. 2019	NINMAS, Dhaka	50
2019 Bangladesh KOICA Workshop on Clinical Nuclear Medicine	KOICA, NINMAS	1- 3 Dec. 2019	NINMAS, Dhaka	30
Training on Dried Blood Spot (DBS) Sample Collection procedure from the Newborn Babies for the Screening of Congenital Hypothyroidism	*ADP Project	18 Nov. 2019	NINMAS, Dhaka	500
National Assessment Workshop on Resident Radiation Oncology Medical Physicists' by IAEA Expert Mission Under the IAEA RCA Project "RAS/6/087: Enhancing Medical Physics Services in Developing Standards, Education and Training through Regional Cooperation (RCA)"	BAEC and IAEA	9-11 Oct. 2019	NINMAS, Dhaka	15

*****Screening of Congenital Hypothyroidism in Newborn Babies (Phase 2)

4. Manpower Development and Training Program

Name of the participant	Title of the event	Organizer	Date	Place
Dr. P. Mutsuddy	Fellowship Training under IAEA TC Project BGD6027 (EVT1906577 - BGD6027)	IAEA	6-31 Jan. 2020	Austin Health, Australia

Name of the participant	Title of the event	Organizer	Date	Place
H. Medhi	FTC on Environ. Radioactivity Monitoring - 2020	TI, AERE	12-16 Jan. 2020	TI, AERE
All doctors, scientists and technologists	Training of HIS, RIS & PACS IT Technology for data/image transfer and manipulation at NINMAS	NINMAS, Dhaka	10 - 12 Dec. 2019	NINMAS, Dhaka
Prof. Dr. F. Nasreen	Public Procurement Audit Management course	BIM	3 - 5 Nov. 2019	BIM, Dhaka
M. N. Hossain and Dr. M. A. Azim	Regional Training Course on the Production and Quality Control of 18F-FDG	IAEA	2 - 6 Sept. 2019	Putrajaya, Malaysia
Prof. Dr. F. Begum, Dr. P. Mutsuddy, Dr. P. Akhter, Dr. T. Mandal and Dr. R. Perveen	Workshop cum training on Gynaecological & Obstatric Ultrasonography	INMAS, Dhaka	15 Jul. 2019	INMAS, Dhaka

5. Seminar/Symposium/Conference/Meeting Attended

Name of the Participant	Title of the event	Organizer	Date	Place
Prof. Dr. F. Begum, Prof. F. Begum, Prof. Dr. Z. Jabin, M. N. Hossain, Dr. J. Frdous, Dr. P. Akhter, M. S. Mia, H. Mehdi and S. C. Biswasarma	International conference on Physics in Medicine	BAEC, BMPA & BMPT, DU	6-7 Feb. 2020	DU & AECD
Sanchoy Chandra Biswasarma	International Conference on Recent Advances in Chemistry (ICRAC) - 2020	Department of Chemistry, JNU	7-8 Feb. 2020	JNU
Prof. Dr. N. Nahar, Prof. Dr. F. Nasreen, M. N. Hossain and Dr. M. A. Azim	Pre-shipment inspection meeting of the fully automated Genetic Screening System: GSP instrument and Automated Neonatal Immunoassay System: Auto DELFIA for Newborn Screening	*ADP Project	27 Jan. - 02 Feb. 2020	Finland
Dr. N. F. Ali and Dr. S. N. Bailey	Community Nutrition: Bangladesh Perspective under Bangladesh University of Health Sciences (BUHS)	Bangladesh University of Health Sciences	10 Jan. 2020	Ibrahim Auditorium, BUHS
M. N. Hossain	3rd International Conference on Physics for Sustainable Development and Technology (ICPSDT-2019)	CUET	18 - 19 Dec. 2019	CUET
M. N. Hossain, Dr. J. Ferdous, M. S. Mia, H. Mehdi, M. A. Islam and S. C. Biswasarma	4th Young Scientist Congress: Young Scientists for Achieving Sustainable Development Goals	Bangladesh Academy of Sciences	13 - 15 Dec. 2019	NMST, Agargaon
M. N. Hossain	National Conference on Electronics and Informatics	BES and BAEC	4-5 Dec. 2019	AECD
Prof. Dr. S. M. F. Begum, Prof. Dr. F. Begum, Prof. F. Begum, Dr. J. Ferdous, Dr. P. Mutsuddy, Dr. R. Perveen, Dr. T. Mandal and Dr. N. F. Ali	2019 Bangladesh KOICA Workshop on Clinical Nuclear Medicine	NINMAS, Dhaka and KOICA	1 - 3 Dec. 2019	NINMAS

Name of the Participant	Title of the event	Organizer	Date	Place
Prof. Dr. F. Begum	Workshop on Good Governance, Right to Information, Citizen Charter.	Platform for Dialogue, NILG, Dhaka	27 - 28 Nov. 2019	NILG, Dhaka
Prof. Dr. Z. Jabin, Dr. J. Ferdous and Dr. R. Perveen	Update of surgical management of breast carcinoma and role of nuclear medicine imaging.	NINMAS	12 Nov. 2019	NINMAS, Dhaka
Prof. Dr. F. Begum, Prof. Dr. Z. Jabin, Dr. J. Ferdous, Dr P. Mutsuddy, Dr. P. Akhter, Dr R. Perveen, Dr. T. Mandal, Dr. N. F. Ali and Dr. S. N. Bailey	3rd National Conference & Annual General Meeting of Bangladesh Thyroid Society	Bangladesh Thyroid Society	15 Nov. 2019	NINMAS, Dhaka
Prof. Dr. F. Begum, Prof. Dr. Z. Jabin, Dr. F. Haque, Dr. P. Mutsuddy, Dr. P. Akhter, Dr. R. Perveen, Dr. T. Mandal, Dr. N. F. Ali and Dr. S. N. Bailey	Bangladesh International Cancer Congress 2019	Oncology Club Bangladesh	11 -12 Oct. 2019	Army Golf Club, Dhaka
Prof. Dr. F. Nasreen	14th ICRT (International Conference on Radionuclide Therapy)	WARMTH	21-25 Aug. 2019	Nanjing, China
M. N. Hossain	Regional Workshop on Train-the-Trainers on the IAEA Comprehensive Clinical Audits for Diagnostic Radiology (QUAADRIL)	IAEA	19 to 23 Aug. 2019	Kuala Lumpur, Malaysia
Prof. F. Begum	Extended Core Committee meeting for International Health Regulation (IHR-2005) focusing on Radiation Hazard	Directorate General of Health Service (DGHS), Dhaka	5 - 6 Aug. 2019	DGHS Mohakhali
Prof. Dr. N. Sultana	Participate as Travel Grant Award winner in 29th Congress of International Society of Ultrasound in Gynecology & Obstetrics (ISUOG) in Berlin, German. 2019	ISUOG	12-16 Oct. 2019	Berlin, German

*****Screening of Congenital Hypothyroidism in Newborn Babies (Phase 2)

6. Collaboration Work(s)

6.1 IAEA TC Project

- IAEA TC Project BGD2016003 "Improved Cancer Management through Capacity Building in Molecular Imaging and Radiation Oncology" (2018-19); Prof. Dr. Shamim Momtaz Ferdousi Begum, National Project Counterpart (NPC)
- IAEA TC Project "Developing Human and Infrastructure for Cyclotron Based Diagnostic Positron Emission Tomography Radiopharmaceutical Production and Radiation Treatment Facilities for Cancer Patients (BGD6028)". Dr. Mohammad Anwar-Ul-Azim, National Project Counterpart (NPC)
- IAEA TC Project Interregional Technical Cooperation (TC) project of International Atomic Energy Agency (IAEA): "Strengthening Capabilities of Member States in Building, Strengthening and Restoring Capacities and Services in Case of Outbreaks, Emergencies and Disasters (INT0098)". Dr. Mohammad Anwar-Ul-Azim, National Project Counterpart (NPC).

6.2 RCA Project

- RCA e-Learning module development on Graves' disease under RCARO project (www.rcaro.org/elearning). Place: South Korea (electronic correspondence). Signing date: May 30, 2019. Period of work: Sept., 2019; Prof. Dr. Zeenat Jabin
- Enhancing Medical Physics Services in Developing Standards, Education and Training through Regional Cooperation (IAEA RCA Project No. RAS/6/087); Md. Nahid Hossain, Alternate National Project Counterpart (ANPC)
- IAEA Reginal Cooperation Project (RCA) Project "Enhancing Capacity and Capability for the Production of Cyclotron Based Radiopharmaceuticals (RAS6097)". Dr. Mohammad Anwar-Ul-Azim, Alternate National Project Counterpart (ANPC)
- Title: Empowering Regional Collaboration among Radiotherapy Professionals through Online Clinical Networks (RCA) Project Number: RAS6096 Project duration (Start date): 2020-01-01 Field of Activity: 26 - Radiation oncology in cancer management Sustainable Development Goal: 03 - Ensure healthy lives and promote well-being for all at all ages; Dr. Nabeel Fahmi Ali, Alternate National Project Counterpart (ANPC).

6.3 CRP (Coordinated Research Project with IAEA) Project

- CRP Project E13044 "PET CT in the evaluation of locally advanced breast cancer under" under the research contact "Locally advanced breast cancer (LABC) neo-adjuvant chemotherapy assessment: a prospective comparative effectiveness study of MRI versus whole body PET-CT versus dedicated breast PET (PEM)"; Prof. Dr. Shamim Momtaz Ferdousi Begum
- CRP Project E13043 "Enhancing capacity of Neuroimaging & biomarkers: Application in early stage Alzheimer's disease with Comorbidities", Dr. Nasreen Sultana.

6.4 Korea International Cooperation Agency project

- KOICA (Korea International Cooperation Agency) project on "Infrastructure Strengthening of Nuclear Medicine in Bangladesh for Treatment of Non-communicable disease" 2018-2020; Local coordinator and advisor of Bangladesh: Prof. Dr. Shamim Momtaz Ferdousi Begum.

6.5 MINISTRY OF SCIENCE & TECHNOLOGY Project

- Government ADP project "Establishment of Positron Emission Tomography Computed Tomography (PET-CT) Technology with Cyclotron facilities"; Project Director: Prof. Dr. Md Nurul Islam
- Government ADP Project: "Screening of Congenital Hypothyroidism in Newborn Babies (Phase 2)"; Project Director: Dr. Mohammad Anwar-Ul-Azim.

7. Research and Development Work(s)

Research Work(s)

7.1 Assessment of neoadjuvant chemotherapy response in locally advanced breast cancer (LABC) in comparison with MRI versus whole body PET/CT

S. M. F. Begum, P. Mutsuddy, T. Mandal and M. Ahmed

This study aims to prospectively investigate the diagnostic accuracy of MRI versus whole body PET/CT, prone PET/CT and dedicated breast PET (PEM) for assessment of response to neoadjuvant chemotherapy in breast cancer patients with pathologic complete response (pCR) as reference standard. Accurate pathological diagnosis of tumor mass before treatment and careful examination of specimens after treatment are main objectives in the diagnostic process of neoadjuvant-treated breast cancer. To achieve the first objective, multiple core biopsies are taken for initial diagnosis and pathology specimen is obtained from mastectomy or lumpectomy at completion of treatment

7.2 Strengthening cancer management through capacity building in molecular imaging technology and radiation oncology

S. M. F. Begum, F. Begum, M. S. Ahsan, T. Mandal, P. Mutsuddy and H. Ara

To upgrade knowledge and skill in molecular imaging specially PET-CT and SPECT - CT for cancer management. Diagnosis, Staging, Restaging and Treatment response evaluation by using FDG PET or PET-CT & Use of other new PET tracers in oncology.

7.3 Vitamin D status among the differentiated thyroid cancer patients attending NINMAS

Z. Jabin, J. Ferdous, U. Islam, F. Haque and F. Begum

This is an ongoing cross sectional observational study of the thyroid division of National Institute of Nuclear Medicine & Allied Sciences (NINMAS). More than 1100 patients who were treated with total thyroidectomy followed by different doses of radioiodine therapy were enrolled in this study. Patients with normal PTH levels were included only. Serum levels of vitamin D, Calcium, PTH were measured and data on histological type and stage of DTC, patient's occupation, sun exposure history and chief complaints were obtained along with informed consent.

Based on vitamin D status, study subjects were stratified in three groups: a) vitamin D deficiency (VDD), reflecting levels under the established threshold of <20 ng/ml; b) vitamin D insufficiency (VDI), reflecting levels 20-<30ng/ml; c) vitamin D sufficiency (VDS), reflecting levels 30-100ng/ml. Concurrent evaluation of vitamin D status of caring physicians were done to find possible factors influencing the lifestyles, ethnicity and environment

7.4 Unusual sternal swelling in differentiated thyroid cancer patients: management dilemmas with follow up analysis

Z. Jabin, J. Ferdous, S. Nahar, N. F. Ali, P. Akhter and F. Begum

Skeletal metastases from differentiated thyroid cancer (DTC) are difficult to treat as they are often resistant to radio-iodine therapy (RAIT). Surgical resection of solitary skeletal metastasis followed by RAIT may offer cure with prolonged survival. Most often, metastases to the sternum present in the guise of primary sternal tumors and often treated surgically without the diagnosis of thyroid cancer in mind. We are following up multiple cases of sternal mass with or without H/O, radical surgical resection of the sternal mass but proved to be a metastasis from follicular carcinoma of the thyroid, appearing before or years after total thyroidectomy and RAIT. We recommend surgical resection of the metastasis as a curative or palliative measure in DTC patients to maximize the effect of subsequent RAIT.

7.5 Radioiodine treated differentiated thyroid cancer patients with lung metastasis and follow up analysis

J. Ferdous, P. Akhter, Z. Jabin and F. Begum

The goal of my work is to make an evaluation and comparison of the efficacy of radio iodine therapy in a patient with differentiated thyroid carcinoma with lung metastases. Lung metastases in DTC is the common site of distant metastases. The prognostic factor and therapeutic efficacy evaluated in this study. The outcome of this disease to date remains so little that adequate outcome have not been tested so far. My work shall help dose determination, prognostic outcome and therapeutic efficacy of RAIT in DTC patients with lung metastases.

7.6 Outcome of radioactive iodine therapy in patient with differentiated thyroid carcinoma associated with B-RAF mutation

P. Akhter

Description: The objective of this study is to find out the association of BRAF mutation in DTC. In this study all patient with DTC will be prepared for radio iodine ablation. All the DTC patient will get radioactive iodine ablation (RAIA). All of them will be followed up for one year. Follow up will be done three monthly by measuring FT3, TSH, Tg, TgAb, USG and finally after one year large dose whole body iodine scan (DxWBS) will be performed. If necessary CT Scan, MRI even PET-CT will be done. After one year of follow up outcome of these patients following radioactive iodine ablation will be observed. It will be easier to predict their outcome, disease progression and above all help to choose correct dose and treatment options for them.

7.7 Thyroid function evaluation in newborn of mothers with differentiated thyroid carcinoma after radioiodine treatment.

R. Perveen

The goal of my work is to make a thyroid function evaluation of the new born baby of mothers treated with radioiodine therapy in a patient with differentiated thyroid carcinoma. In this study we can determine the thyroid functional status of the new born after delivery.

7.8 A Radiological retrospective study of cyberknife sbrt in Nsclc in cancer center of union hospital

N. F. Ali, W. Gang and M. Rui.

This is an institution based clinical research protocol for retrospective evaluation of patients treated with Cyberknife modality of Stereotactic Body Radiotherapy (SBRT) in Non-Small Cell Lung Cancer (NSCLC) patients as conducted in Cancer Center of Union Hospital, Tongji Medical College, Huazhong University of Science and Technology. All processes within this human study were conducted in compliance with the approval of the Ethical Committee of Tongji Medical College, Huazhong University of Science and Technology. Upon completion of paper it has upheld three new frontiers of analyzing radiotherapy delivery protocol and sufficient substance to call upon further changes into Response Evaluation Criteria for Solid Tumors (RECIST) Version 1.1.

7.9 Cardiac diverticulum: Morphological analysis based on CT and MR imaging

S. N. Bailey, S. Heshui, S. Heshui, O. A. Walid, N. F. Ali, A. Hossain, X. Yu and L. Y. Min

The goal of my work is to make an evaluation and comparison of the diagnosis and efficacy of CT Scan and MRI in this particularly rare disease. The incidence of this disease to date remains so little that adequate diagnostic modalities have not been tested so far. My work shall help enlighten the diagnosis and thus help to guide better the therapeutic and prognostic outcome of this case on an international arena.

7.10 In-House Researches

- Survey of Quality of life in thyroid carcinoma patients with long term levothyroxine supplementation; Prof. Dr. Fatima Begum and coworkers
- Pattern and analysis of high antiTgAb levels in Thyroid Carcinoma Patients; Prof. Dr. Fatima Begum and coworkers
- Individual monitoring of Internal Exposure for Nuclear Medicine Workers in NINMAS through in vitro bioassay techniques. Prof. Ferdoushi Begum and coworkers
- Estimation of Internal Radiation Doses for Occupational Workers Due to ^{131}I Radionuclides by Using MONDAL Software. Prof. Ferdoushi Begum and coworkers
- Evaluation of Internal exposure of Nuclear medicine personnel in NINMAS Dhaka through in vivo and in vitro bioassay techniques. Prof. Ferdoushi Begum and coworkers
- Assessment of Environ. Toxicity of Some Waterfall Areas of Bangladesh by PIXE Technique and Radionuclides detection Using Gamma Spectrometry. Prof. Ferdoushi Begum and coworkers
- Evaluation of PET-CT in gastrointestinal carcinoma- Prof. Dr. Shamim Momtaz Ferdousi Begum, Dr. Abu Bakker Siddique and coworkers
- Role of PET-CT in evaluation of treatment response in lung carcinoma- Prof. Dr. Shamim Momtaz Ferdousi Begum and coworkers
- Experience of PET-CT in adult lymphoma- Prof. Dr. Fatima Begum and coworkers
- Experience of PET-CT in breast cancer- Prof. Dr. Shamim Momtaz Ferdousi Begum and coworkers
- Protocol development for the contraindication of stress myocardial perfusion study in main trunk stenosis in collaboration with cardiologists- Prof. Dr. Shamim Momtaz Ferdousi Begum, Dr. Tapati Mandal and Dr. Pupree Mutsuddy
- Followup for intervention adopted in reversible perfusion defect in MPI- Prof. Dr. Shamim Momtaz Ferdousi Begum, Dr. Tapati Mandal and Dr. Pupree Mutsuddy
- Longterm Follow up of radioiodine treated thyroid carcinoma with lymphnodes metastases

  Prof. Dr. Fatima Begum, Dr. Sharmin Quddus, Dr. Farhana Haque, Dr. Sharmin Reza, Dr. Rahima Perveen and Dr. Urnas Islam
- Role of posttherapy scan in evaluation of hidden lungs metastases in patients with differentiated thyroid carcinoma- Dr. Sharmin Quddus, Dr. Farhana Haque and Co-workers
- Metastases in unusual sites from differentiated thyroid carcinoma-Dr. Rahima Perveen, Dr. Urnas Islam and co-workers

- Duplex study of vertebral arteries in patients- Dr. Fazlul Bari and coworkers
- Assessment of carotid vessels in DM and TIA - Dr. Nasreen Sultana and coworkers
- Musculoskeletal ultrasonography of different limb joints and injury- Dr. Fazlul Bari, Dr. Abu Bakker Siddique and coworkers
- Duplex study of uterine artery to predict pre- eclampsia. Case- control study. Dr. Abu Bakker Siddique and coworkers
- Duplex study of penile vessels in erectile dysfunction. (Pharmaceutical augmented). Dr. Abu Bakker Siddique, Dr. Fazlul Bari
- Elastoscan of thyroid nodule- Dr. Fazlul Bari and coworkers
- Less fetal movements and oligohydraamnios associated with high S/D ratio of umbilical artery Dr. Nasreen Sultana and co-workers.

7.11 Development Work(s)

- Development of COVID19 safety protocol for NINMAS patient management and PET-CT imaging procedure. Prof. Dr. Shamim Momtaz Ferdousi Begum and coworkers
- Development of SOPs for PET-CT technical, patient management and both patient and staff safety. Prof. Dr. Shamim Momtaz Ferdousi Begum and coworkers
- Introduction of Telemedicine for PET-CT patient during COVID crises. Prof. Dr. Shamim Momtaz Ferdousi Begum and coworkers
- Initiated telemedicine during Covid-19 pandemic situation since Apr. 2020 to give suggestions for thyroid related patients from Thyroid Division, NINMAS. Prof. Dr. Fatima Begum and coworkers
- Capacity building of the entire telemedicine team of Thyroid Division to ensure better quality of service. Prof. Dr. Fatima Begum and coworkers
- Initiated and facilitated infrastructure upgradation, especially for safe patient handling of Thyroid Division. Prof. Dr. Fatima Begum and coworkers
- Prepared Standard Operating Procedure (SOP) for safe patient handling during Covid-19 for staff and physicians for Thyroid division. Prof. Dr. Fatima Begum and coworkers
- Development and Upgrading of Hot-lab facilities of NINMAS; Prof. Ferdoushi Begum, Md. Nahid Hossain and coworkers
- Development/Improvement of the radioactive waste management procedure and facility at the Institute; Prof. Ferdoushi Begum, Md. Nahid Hossain and coworkers
- 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
- Installation of view box in reporting room for viewing CT, MRI and X-ray reports of the patients. Prof. Dr. Zeenat Jabin and coworkers
- Screening of Congenital Hypothyroidism with the aid of Dissociation Enhanced Lanthanide Fluorescence Immunoassay (DELFIA) and Immunoradiometric Assay (IRMA) technique from Dried Blood Spot (DBS) samples. Dr. Mohammad Anwar-Ul-Azim and coworkers.

8. Repair & Maintenance, Renovation work(s)

- Initiated and facilitated infrastructure development in patient handling by installing protective tables for doctors and receptionists in Thyroid Division. Prof. Dr. Fatima Begum and coworkers
- Facilitated the arrangement and installation of hand washing stations at the entrance of NINMAS for patients and all people entering Block-D of BSMMU during this corona crisis since May 2020. Prof. Dr. Fatima Begum and coworkers
- Oversee the QC Program of Nuclear Medicine Instruments and assisted in repair and maintenance of various equipment; Prof. Ferdoushi Begum, Md. Nahid Hossain and coworkers

- Repair and Maintenance of the Fluorescence Immunoassay and Immunoradiometric Assay analyzer for the measurement of newborn's Thyroid Stimulation Hormone. Dr. Mohammad Anwar-Ul-Azim and coworkers
- Renovation of Immunoassay laboratories to build a dedicated Newborn Screening laboratory with most advance and automated immunoassay instruments at NINMAS**.** Dr. Mohammad Anwar-Ul-Azim and coworkers.

9. Service Rendered and Revenue Income

Nature of the sample	No. of sample	Income
Patient	60844	57582476/-
Blood Samples Analysis	29015	
Newborn's dried blood spot samples	280000	
Newborn babies diagnosed of congenital hypothyroidism	119	
Total	369978	57582476/-

INSTITUTE OF NUCLEAR MEDICINE & ALLIED SCIENCES (INMAS), DHAKA

Introduction

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 head & Single head Gamma Camera, thyroid scanner, 2D & 3D ultrasound scanner, Color Doppler scanner, BMD and in vitro procedure etc. significant number of patients health care services are offered from this institute as regular basis.

Activities

1. Manpower Development and Training Program

Title of the event	Date	Place	No. of participant
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. J. A. Haque, Dr. S. K. Biswas and Dr. R. Begum	31th National conference	Bangladesh Society of Ultrasonography	11-12 Oct. 2019	NINMAS & Eastern Plaza, Dhaka
	3rd National conference	Bangladesh Thyroid Society	15 Nov. 2019	NINMAS, Dhaka
	23 WFUMB Centre of Education Workshop	Bangladesh Society of Ultrasonography	06-07 Mar. 2020	NINMAS, Dhaka
Dr. F. S. Haque	23 WFUMB Centre of Education Workshop	Bangladesh Society of Ultrasonography	06-07 Mar. 2020	NINMAS, Dhaka
Dr. F. Rahman, Dr. M. Hossain, Dr. T. Sultana, Dr. F. S. Haque and Dr. A. Akhter	31th National conference	Bangladesh Society of Ultrasonography	11-12 Oct. 2019	NINMAS & Eastern Plaza, Dhaka

Name of the participant	Title of the event	Organizer	Date	Place
Dr. R. Afrin	31th National conference	Bangladesh Society of Ultrasonography	11-12 Oct. 2019	NINMAS & Eastern Plaza, Dhaka
	International Interventional Radiology	Bangladesh Society of Radiology & Imaging	12-13 Oct. 2019	NINMAS, Dhaka
	Fetocon Dhaka 2020 1st International Conference of Society of Fetomaternal Radiology, Bangladesh	Bangladesh Society of Radiology & Imaging & Society of Fetal Medicine, India	01-02 Feb. 2020	Sheikh Hasina National Institute of Burn and Plastic Surgery Bangladesh
Dr. S. Hossain and Dr. S. Sharmin	31th National conference	Bangladesh Society of Ultrasonography	11-12 Oct. 2019	NINMAS & Eastern Plaza, Dhaka
	3rd National conference	Bangladesh Thyroid Society	15 Nov., 2019	NINMAS, Dhaka
Dr. M. R. Mozumder	1st International Master Class on Interventional Ultrasound	Shristy Institute of Ultrasonography	16-17 Nov. 2019	INMAS, Dhaka Auditorium
Dr. S. Islam	Gynaecological & Obstetric Ultrasonography Triad & Triumph	INMAS, Dhaka	15 Jul. 2019	INMAS, Dhaka Auditorium
	Nuclear & Radiological emergency preparedness course	BAEC & JAEA	24 Nov. - 05 Dec. 2019	TI, AERE

3. Collaboration Work/MoU

- 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.
- Taken classes to medical students (under & post-graduates) and trainees, demonstrations to medical students (under & post-graduates) and trainees, attended scientific seminars & workshops, Helped in student co-ordination.

4. Service Rendered and Revenue Income

Name of service	No. of patient/sample	Income
Patient Service	41520	33802560/-
Sample analysis (including blood sample)		
Total	41520	33802560/-

INSTITUTE OF NUCLEAR MEDICINE & ALLIED SCIENCES (INMAS), MITFORD

Introduction

INMAS, Mitford is situated in the campus of Sir Salimullah Medical College and Mitford Hospital Campus in the old part of Dhaka city.

Objectives

- 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 Services

1.1 Diagnostic service

- Scintigraphic scan includes Bone scan, Cardiac MPI, 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 and Color Doppler of vascular system are routinely performed.
- In Vitro diagnostic services includes hormone analysis like T3, T4, FT3, FT4, TSH, FSH, LH prolactine, testosterone, estrogen, progesterone. Different types of thyroid antibody and tumor marker Tg are routinely performed in this institute.

1.2 Therapeutic service

Therapeutic activities include treatment of thyroid cancer and hyperthyroid patients using I-131

2. Research and Development Work(s)

In-house Researc

- Determination of active phase of bony metastatatic lesion by three phase bone scan
- The functional state of salivary gland in Ca. Thyroid patient after getting radioiodine ablation.
- Detection of gastric emptying time in long standing diabetic patient.

3. Manpower Development and Training Program

Title of Event	Date	Place	No of participant
Operational management of SPECT/CT	9 Aug. 2019	INMAS	4
Fundamentals of radiation protection	20/10/19	INMAS	6
Operation of Electrical and electronic equipments	4 Nov. 2019	INMAS	6

4. Seminar/Conference/Workshop/Meeting Attended

Name of the participent	Title of the event	Organizer	Date	Place
Dr. H. A. Rahman	Fellowship training on clinical application of n1PET/CT	Austine Hospital	1-30 Jan. 2020	Melbourne, Australia
Dr. H. A. Ara Rahman, Dr. S. Sharmin and Dr. A. Nazneen	1st Internatioanl Master Class on Interventional Ultrasound	Shristy Institute for Health Science	16-17 Nov. 2019	INMAS, Dhaka
	Obstetric Ultrasound: Triad & Triump	INMAS, Dhaka	15 Jul. 2019	INMAS, Dhaka
Dr. J. Hossain	15th Annual Conference of BSRI	Bangladesh Radiology Society	28 Jul. 2019	Dhaka
Dr. H. A. Rahman, Dr. J. Hossain, Dr. S. Sharmin and Dr. A. Nazneen	31st National Conference and General Meeting of BSU	Bangladesh Society of Ultrasonography	11-12 Oct. 2019	NINMAS, Dhaka
Dr. S. Sharmin and Dr. A. Nazneen	Annual Conference of Bangladesh Thyroid Society	Bangladesh Thyroid Society	15 Nov 2019	Dhaka

Name of the participent	Title of the event	Organizer	Date	Place
A. Khadija	Radiation Protection for Radiation Workers and RCO's of BAEC	BAEC	15-19 Sept. 2019	TI, AERE
S. A. Chowdhury	PPR 2008 and Public Procurement management	BIM	15-26 Sept. 2019	BIAM, Dhaka
M. S. I. Khan	Dried blood spot (DBS) sampling collection procedures for congenital Hypothyroidism	NINMAS	17 Nov. 2019	NINMAS, Dhaka

5. Others

- Lectures are delivered to M.Phil/MD/MS students of different discipline of SSMCH, Mitford
- Lectures delivered to MD (Nuclear Medicine) students
- Monthly in-house meeting and Seminar is held regular.

6. Service Rendered and Revenue Income

Name of service	No. of patient	Income
Patient Service (USG, Scintigraphy, Radioiodine therapy, Follow-up of patients, Telemedicine)	14301	12206650 /-
Blood Sample Analysis (Hormone analysis)	6949	

INSTITUTE OF NUCLEAR MEDICINE & ALLIED SCIENCES (INMAS), CHATTOGRAM

Objective/Introduction

Institute of Nuclear Medicine & Allied Sciences, Chittagong 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, CT Scanner, Thyroid Scanner, Ultrasonogram, Colour Doppler and In-Vitro Laboratory for Radioimmunoassay (RIA) with Computerized Gamma Well Counter and other necessary facilities.

Activities

1. Services

1.1 Radionuclide imaging

Bone Scan, Renogram, Renal Scan, Thyroid Scan, Liver Scan, RBC Scan, parotid scan, testicular scan, parathyroid scan, HIDA scan etc.

1.2 Radionuclide Therapy

- Radio Iodine therapy for thyrotoxicosis and Ca-thyroid patients
- Radiation therapy after pterygium operation of eye.

1.3 Radioimmunoassay

T3, T4, TSH, FT3, FT4, & TG and also several other hormones like LH, FSH, Prolactin, Testosterone, Progesterone, Oestradiole, AFP and Cortisol etc.

1.4 Ultrasound

- General Ultrasound (Whole Abdoment, Lower/Upper Abbomen, Pregnancy profile, HBS, KUB etc.)
- High Reslution Ultrasound (Thyroid, Scrotum, Breast, Endocavitary Studies etc.).

1.5 Colour Doppler

Lower Limbs, Upper Limbs, Carotid Arteries, Testis, Pregnancy etc.

1.6 Thyroid Clinic

Thyroid cancer, hyperthyroidism, hypothyroidism patients came for treatment and follow up.

2. Manpower Development and Training Program

Title of the event	Date	Place	No. of participant
Training on Online office Management Google G Suite	14-25 Jul. 2019	BIM, Dhaka	01
Training on Automated RIA Analyzer Accessories	26 Aug. - 1 Sept. 2019	India	02
Training on e-Nothi Course	25 Aug. - 29 Sept. 2019	RPATC, Ctg.	02
Training on e-Nothi Course	21 Dec. 2019	INMAS, Ctg.	06
Training on Cyclotron Operation	23 Dec. - 5 Jan. 2020	Thailand	01
Clinical & Operational Training of CT Machine	19 - 25 Jan. 2020	India	02
Training on Dual Head SPECT-CT	7 - 20 Feb. 2020	Germany	02

3. Other

- Eleven students of Chattogram Polytechnique Institute participated to three months Nuclear Medicine Instrumentations training in our Institute and successfully completed that training
- Forty six students of Chittagong Institute of Medical Technology participated in a two weeks Nuclear Medicine Instrumentations training in our Institute and successfully completed that training.

4. Service Rendered and Revenue Income

Name of service	No. of patient	Income
Patient service	44633	27462700/-

INSTITUTE OF NUCLEAR MEDICINE & ALLIED SCIENCES (INMAS), MYMENSINGH

Objective/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 Dept. 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.

All the necessary in formations are in our own website www.inmasmym.org

Activities

1. Medical services

Diagnosis of diseases and treatment of a number of diseases.

2. Research and Development Work(s)

- Developing facility to start post graduate MD residency course in Nuclear Medicine under BSMMU
- To provide attachment training to the Post graduate medical students in their MD, MS residency program.

3. Collaboration Work(s)

IAEA RCA Project "Strengthening Hybrid Imaging in Nuclear Medicine in Asia (RAS 6079)"

4. Lecture Delivered

- Series of lecture 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
- Post graduate students of MD (Radiology & Imaging) and MS (Surgery, Pediatric surgery), Diploma Endocrine Medicine of MMC attended in a series of classes on Nuclear Medicine in this Institute.

5. Manpower Development/Training Program

Name of the participant	Title of the event	Date	Place	No. of participant
Dr. R. Ara et al.	Clinical Meeting on FDG PET-CT in common Malignancies	28 Nov. 2019	MMC	86
Dr. M. Nadiruzzaman et al.	Evaluation of osteoporosis using DEXA scan among low income group women in south India	03 Feb. 2020	MMCH	78
All Doctors & Staff	Seminar on COVID-19 Epidemic Precaution & Prevention	18 Mar. 2020	INMAS, Mymensingh	56

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

Name of the participant	Title of the event	Organizer	Date	Place
Dr. R. K. Chakraborty, Dr. S. Z. Rima, Dr. N. Nahar and Dr. F. A. Dowel	WFUMB Center of Education Workshop of The World Federation ofr Ultrasound in Medicine and Biology.	NINMAS	6 -7 Mar. 2020	Dhaka
Dr. S. Z. Rima and Dr. F. A. Dowel	Workshop cum training Program on Gynaecological and Obstetric Uttrasonography: Triad and Triumph held	NINMAS	15/07/2019	Dhaka
Dr. M. Nadiruzzaman and Dr. F. A. Dowel	2019 Bangladesh KOICA Workshop under KOICA Project : Infrastructure String thening project of Nuclear Medicine in Bangladesh for Treatment of Non-communicable Disease	NINMAS	01-03 Dec. 2019	Dhaka
Dr. M. N. Khan, Dr. M. Nadiruzzaman and Dr. F. A. Dowel	Visiting Expert Assisted Local Education workshop and Remote Seminar of Nuclear Science	NINMAS	01-03 Dec. 2019	Dhaka
Dr. G. A. Hossain and Dr. R. K. Chakraborty	Training on HS60 Ultrasound Scannar & Color Doppler	Samsung Medison Co. Ltd.	21 - 26 Oct. 2019	Korea

7. Others

- The Institute provides research facility for post graduate students of MD, MS, M Phil & PhD program
- 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.

8. Service Rendered and Revenue Income

Name of service	Nature of service	No. of patient	Income
Hormone assay, Tumor marker assay; Brain, Bone, Kidney, Liver & Thyroid scanning; Renography, Lymphoscintigraphy and Conventional Ultrasonography, Color Doppler studies, Interventional Ultrasonography & BMD	Diagnostic and Therapeutic Service	64747	39782550/-

INSTITUTE OF NUCLEAR MEDICINE & ALLIED SCIENCES (INMAS), SYLHET

Objective/Introduction

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 resolusion USG of superficial organs and color Doppler study of vascular system are routinely performed
- Thyroid related hormones, gonadal hormones of both male and female, tumor markers are regular diagnostic procedures
- Different radionuclide scanning and thyroid uptake study are being performed regularly
- Bone Mineral Densitometry (BMD) is a routine examination procedure now.

1.2 Therapeutic

- Treatment of thyroid cancer and hyperthyroidism are regular ongoing procedures
- Treatment is also being given to hypothyroidism, simple goiter, nodular goiter etc.

2. Others

- Post Graduate Residency Training in Nuclear Medicine for MS and MD students of Sylhet MAG Osmani Medical College
- Lectures delivered to the undergraduate medical students regarding Nuclear Medicine technologies and ultrasound
- Scientific seminars on different publications and new cases take place time to time
- Scientific Training of 15 Post graduate students of different faculties regarding Nuclear Medicine.

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

Name of the participant	Title of the event	Organizer	Date	Place
Dr. K. Nahar	Clinical Training on high grade color Doppler	Modernization Project	18-31 Aug. 2019	Mumbai, India
Dr. K. Nahar, Dr. A. Hussain and Dr. H. Tasnim	31st National Conference of the Bangladesh Society of Ultrasonography and fetal anamaly Scanning and interventions. Workshop of the Society of Ultrasonography	INMAS, Dhaka	11-12 Oct. 2019	INMAS, Dhaka
Dr. K. Nahar and Dr. A. Hussain	Visiting Expert assisted Local education Workshop and Remote Seminar of Nuclear Science	KOICA Project	01-03 Dec. 2019	INMAS, Dhaka

Name of the participant	Title of the event	Organizer	Date	Place
Dr. K. Nahar	E-Nothi Training Programe	BAEC	26 Feb. 2020	BAEC, Dhaka
Dr. M. M. A. Z. Bhuiyan	Infrastructure Strengthening Project of Nuclear Medicine in Bangladesh for Treatment of Non-communicable Disease	Under the KOICA Project	15 Apr. 2019 14 Apr. 2020	South Korea
Dr. M. S. Munir	Workshop Cum Training Program on Gynecological and obstetric Ultrasonography, Triad and Triumph	BAEC	15 Jul. 2019	INMAS, Dhaka
Dr. A. Hussain	Training Course on Radiation Protection for Radiation workers and RCOs of BAEC, Medical Facilities and Industries	TI, AERE	15-19 Sept. 2019	AERE
M. M. Hossain	PPR 2008 and Annual Procurement Planning 2019	BIM, Dhaka	20-24 Oct. 2019	BIM, Dhaka

4. Service Rendered and Revenue Income

No. of patient	Income
17664	10220250/-

INSTITUTE OF NUCLEAR MEDICINE & ALLIED SCIENCES (INMAS), RAJSHAHI

Objective/Introduction

Institute of Nuclear Medicine & Allied Sciences (INMAS), Rajshahi is located North West part of the country. This Institute provides services to the people of greater Rajshahi and nearby districts using nuclear technology and Ultrasound system and made a great impact in this region of the country for betterment of health services.

Activities

1. Manpower Development and Training Program

Title of the event	Date	Place	No. of participant
Updates in Nuclear Medicine: BMD & PET-CT	26 Oct. 2019	RMCH	343
4th year students of Dept of Bio-chemistry & Molecular Biology, RU	03 - 9 Feb. 2020	INMAS, Rajshahi	10
Students of MD (Oncology) RMC were placed here for carried out their theoretical and practical classes	16 - 20 Nov. 2019	INMAS, Rajshahi	02
Students of Diploma in laboratory medicine, New Ideal Medical Institute & Technology, Chuadanga	02- 23 Dec. 2019	INMAS, Rajshahi	02
Students of Diploma in Medical technology, IHT, Rajshahi	21-31 Jul. 21-31 Aug. 21 Sep. -1 Oct. 22 Oct. - 1 Nov. 2019	INMAS, Rajshahi	41

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

Name of the participant	Title of the event	Organizer	Date	Place
Dr. N. Begum	Clinical Training on Ultrasonogram	Philips	18-30 Aug. 2019	India
	23rd WFUMB Center of Education Workshop	Society of Ultrasonogram	06-07 Mar. 2020	Dhaka
	Basic principles of Doppler Ultrasound	Society of Ultrasonogram	28 Feb. 2020	Dhaka
Dr. M. S. Ahsan	Online Office Management-Google G Suite (15th Batch)	BIAM	14-25 Jul. 2019	Dhaka

Name of the participant	Title of the event	Organizer	Date	Place
	PPR 2008 and public procurement management	BIAM	28-31 Jul. 2019	Dhaka
	Visiting expert assisted local education workshop and remote seminar of nuclear science	KOICA project	01-04 Dec. 2019	Dhaka
M. S. I. Chowdhury and M. N. Huda	RIA Analyzer with accessories	Perkin Elmar	26 Aug.- 01 Sept. 2019	India
J. A. Khan	DBS sampling procedure for the screening of congenital hypothyroidism in newborn babies	INMAS	18 Nov. 2019	Dhaka

3. Other

Building construction & New medical equipment set up is going on under the project of Enhance capacity of INMAS, Rajshahi.

4. Service Rendered and Revenue Inccome

Name of service	No. of patient	Income
Patient service	32258	20920400/-
Sample Analysis (blood)	34353	

INSTITUTE OF NUCLEAR MEDICINE & ALLIED SCIENCES (INMAS), DINAJPUR

Objective/Introduction

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 district. In the following decades the Institute served a huge number of patients with Thyroid Disorders. The main objective is to serve goitre affected person both in diagnosis and treatment. At the stage of establishment institute only confined to treat Thyrotoxic patient by 131-I but at present we also treat Thyroid Cancer affected person by 131-I ablation in a adition to toxic patient treatment. Thyroid disease related research activities also done in this institute for the last decades.

Activities

1. Research and Development Work(s)

Pattern of thyroid disorder among different age groups in Dinajpur: Nuclear medicine view

M. M. A. Hossain, M. S. Salekin, B. K. Bose and K. R. Rimi

Application of Nuclear Medicine technique in the diagnosis of Thyroid disorder play a major part in INMAS, Dinajpur which was established in 1982. Patients were referred here from different hospitals and private practitioners to evaluate the Thyroid gland and Thyroid hormone related disorders. 99_mTC pertechnetete Thyroid scan for thyroid scientigraphy, RIA and IRMA for hormonal assay are frequently performed procedures in our institure. We evaluate the different types of Thyroid disorder in Dinajpur, like simple goitre, diffuse toxic goitre, Multinodular goitre, either toxic or not, Thyroiditis etc. Dinajpur is a goitre prevalance zone and the incidence of Thyroid disorder is higher in female among female of middle age group. The common form of Thyroid disorder are iodine deficiency disorder (42.85%) in the age group of 7 to 20 yrs; toxic diffuse goitre (14.20%) in the age group of 20 to 40 years and non-toxic Multinodular goitre (31.73 %) in the age group of 40 to 80 years. In our study it reveals that Thyroid scientigraphy and hormonal assay can diagnose majority of Thyroid disorders especially IDD. Thyroiditis and diffuse toxic goitre.

2. Repair & Maintenance and Renovation Works

Under the project of "Enhancing Capacity of INMAS at Dhaka, Chittagong, Khulna, Sylhet, Rajshahi, Dinajpur and Rangpur" construction works is going on. Thyroid Uptake System, BMD Machine, Color Doppler Ultrasonography, Dual Head SPECT Machine also installed in the institute by this project. A six Stared new building RIA lab also newly equiped with mordern equipments by this project.

3. Services

3.1 Diagnostic

In-vivo technique

- Thyroid Scanner: 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 SPECT machine
- 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.

In-vitro technique

Thyroid related hormones (T_3, T_4, TSH, FT_3, FT_4, Tg and Antithyroid Antibody) are being estimated in the lab by Radio Immunoassay (RIA) technique with modern instruments.

Ultrasonogram with color Doppler

Ultrasonogram both conventional and Color Doppler ultrasound available here

3.2 Therapeutic

3.2.1 Radioactive Iodine (I-131) is used for treatment of thyrotoxicosis and thyroid cancer

3.2.2 Sr-90 is used after Pterygium operation of eye.

4. Manpower Development and Training Program

Title of the event	Date	Place	No. of participant
Clinical Training on High Grade Color Doppler Ultrasound	19-31 Aug. 2019	India	1
Training Course on Radiation Protection for Radiation Workers and RCO's of BAEC, Medical Facilities & Industries	15-19 Sept. 2019	TI, AERE	1

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

Name of the participant	Title of the event	Organizer	Date	Place
Dr. J. B. Munni, Dr. Sweety, Dr. I. Sarmin, Dr. B. K. Bose, Dr. M. Nusrat, Dr. M. T. Hasan and et al.	Ultrasography and BMD	INMAS, Dinajpur	31 Dec. 2019	INMAS, Dinajpur
Dr. I. Parveen, Dr. Ferdousi, Dr. B. K. Bose, Dr. M. Nusrat, Dr. M. T. Hasan and et al.	Diagnosis of Osteoporosis by BMD	INMAS, Dinajpur	8 May 2019	INMAS, Dinajpur

6. Collaboration Work/MoU

- Reducing the shortage of oncology professionals through on applied sciences of oncology course (ASOC) - RAS/6/066 (RCA Project)
- Working as a member of QTR organised by BAEC, Ordar No: 39.01.0000.220.27.006.20.75.(75)/855 Date: 08.6.2020.

7. Other

Preparation of Thyroid Cancer and Toxic patients management books for the institute according to SNMB Guidelines

8. Service Rendered and Revenue Income

Name of service	No. of patient	Income
Patient Service	716	143200/-
Sample Analysis (including blood sample)	4286	3450500/-
Thyroid Scan, Ultrasonography and others	2060	1212500/-
Total	7062	4806200/-

INSTITUTE OF NUCLEAR MEDICINE & ALLIED SCIENCES (INMAS), RANGPUR

Objective/Introduction

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

Name of the participant	Title of the event	Organizer	Date	Place
Dr. M. M. Ali	The Regional Workshop on Nuclear Medicine Applications (SPECT and PET) in the Diagnosis of Neurological Conditions	Project Director	29 Jul.-02 Aug. 2019	Tokyo, Japan
Dr. S. A. Choudhury	Clinical Training on High Grade Color Doppler Ultrasound	Project Director	19-31 Aug. 2019	India
	Nuclear Technology Seminar-2019: Basic Radiation Knowledge for School Education Course	IAEA	24 Oct.-08 Nov. 2019	Japan
Dr. M. Jahan	Chinical and Operational Training on Bone Mineral Densitometry (BMD) at Medilink, 393 Rue Charles Lindbergh, 34130 Mauguio	Project Director	18-24 Nov. 2029	France

3. Academic

- The Institute is carrying out academic activities in Collaboration with the Dept. of Physiology, Endocrinology, Gyenocology & Oncology Dept of Rangpur Medical College Hospital
- Arranged scientific & technical discussions on Nuclear Medicine & Ultrasonography for our newly appointed doctors & scientists.

4. Service Rendered and Revenue Income

No. of patients	Income
18797	10621000/-

INSTITUTE OF NUCLEAR MEDICINE & ALLIED SCIENCES (INMAS), KHULNA

Objective/Introduction

- 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 work(s) in the relevant fields.

Activities

1. Research and Development Work(s)

- Value of Tc-99m-DTPA Scintigraphy in patients with Renal ectopia
- Role of Transvaginal Sonography for folliculometry in patient with infertility

2. Manpower Development and Training Program

Title of the event	Date	Place	No. of participant
In-house workshop on Laboratory acciderrt/emergency	24 Sept. 2019	INMAS, Khulna	7
In-house workshop on BMD	8-9 Dec. 2019	INMAS, Khulna	6
In-house workshop on "Dual Head SPECT"	11-16 Jan. 2020	INMAS, Khulna	15

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

Name of the participant	Title of the event	Organizer	Date	Place
Prof. Dr. A. K. Paul	16th Khulna District Medical Conference of BPMPA	BPMPA, Khulna	06 Mar. 2020	Khulna

4. Academic

- Post-graduate students and Internee doctors of Medicine Dept., Khulna Medical College received training of Thyroid disease management from Thyroid Clinic
- Clinical students of Khulna Medical College, Students of Khulna University of Engineering and Technology and Khulna Polytechnique Institute were placed for theoretical and practical classes
- Arranged Seminar/Journal review on Nuclear Medicine, Ultrasound procedures and related subjects monthly.

5. Service Renderd and Revenew Income

Name of the service	No. of patient	Income
Patients service including Ultrasound and etc.	29005	159411001-

INSTITUTE OF NUCLEAR MEDICINE & ALLIED SCIENCES (INMAS), BARISHAL

Objective/Introduction

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 and another single head gamma camera, thyroid uptake system and three ultrasonography machine with Colour Doppler, Elastoscan and 3D/4D facilities and a RIA Laboratory.

1. Activities

1.1 Diagnostic

- **Ultrasonography and Color Doppler**

Ultrasonography is the main diagnostic tool of the Institute. More than 50% of patients are handled through this system. Sonography of abdominal organs, 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 and other organs is being done routinely. Elastoscan, endocavitary scan and 4D Ultrasonography of fetus & different organs are also done here.

- **RIA laboratory**

Serum T_3, T_4, TSH, FT_3, FT_4, FSH, LH, Prolactin, Progesterone, Testosterone, Tg, Anti TgAb, TPO Ab, TMAb are confidently estimated weekly and fortnightly.

- **Nuclear Medicine**

Bone scan, Renal scan, Renogram, Liver-spleen scan, Hepatobiliary scan, Meckel's Scan, Thyroid scan, MIBI scan and whole body ^{131}I scans are routinely done.

1.2 Therapeutic

- 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 Work

- Renovation of RIA lab with a new gamma counter
- Installed water purifiers for safe drinking water for patients and staffs.

4. Manpower Development and Training Program

Title of the event	Date	Place	No. of participant
Arranged In-house Training for Officer & Staff INMAS, Barishal	Aug. 2019-Mar. 2020	INMAS, Barishal	30
Honorary training course on Ultrasonography and Nuclear Medicine for doctors.	Jul. - Dec. 2019	INMAS, Barishal	2
Updates in Nuclear Medicine and Screening of Congenital Hypothyroidism in Newborn Babies	24 Feb. 2020	Sher-E-Bangla Medical College, Barishal	300

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

Name of the participant	Title of the event	Organizer	Date	Place
Dr. N. Jahan	Training Course on Public Financial Management (20th batch)	NAPD Ministry of Planning	28 Jul. -01 Aug. 2019	Dhaka
	31st National Conference of The Bangladesh Society of Ultrasonography	BSU	11 Oct. 2019	NINMAS, Dhaka
	Workshop on Fetal Anomaly Scanning and Interventions.	BSU	12 Oct.	INMAS, Dhaka
	Day-long Training Course on E-filing	BAEC	26 Feb 2020	Dhaka
Dr. F. Sharmin	Basic Radiation Knowledge for School Education Course	IAEA	24 Oct-08 Nov. 2019	Japan
Dr. N. Jahan	Obstetric Ultrasound triad & triumph	BAEC	15 Jul. 2019	INMAS, Dhaka
	Environment Radioactivity Monitoring Course at BAEC (ERMC-8)-2020	TI, AERE	12-16 Jan. 2020	TI, AERE
Dr. T. Ahmed and Dr. M. S. Hossen	Visiting Expert assisted local education workshop and remote seminar of Nuclear Science under KOICA Project (2019-20)	BAEC	1-3 Dec. 2019	NINMAS, Dhaka
D. S. Kumar	Public Procurement Processing Approval Procedure	BIM	26-29 Aug. 2019	BIM, Dhaka
M. M. U. Alhmahomud	Public Procurement Processing Approval Procedure	BIM	26-29 Aug. 2019	BIM, Dhaka
	Motivating People at Workplace	BIM	21-22 Oct. 2019	BIM, Dhaka

Name of the participant	Title of the event	Organizer	Date	Place
Eng. M. S. Kabir	PPR 2008 and Annual Procurement Planning	BIM	20-24 Oct 2019	BIM, Dhaka
S. C. Mandal	Spread Sheet Analysis with MS Excel	BIM	21-24 Jul. 2019	BIM, Dhaka
M. S. Rahman and M. Khanom	Government Office Management & Efficient Development Course	BIM	28-29 Jul. 2019	BIM, Dhaka
Assaduzzaman	Attended The training on Dried Blood Spot Sampling Procedure for the Screening of Congenital Hypothyroidism in Newborn Babies under ADP project	BAEC & NINMAS	18 Nov. 2019	NINMAS, Dhaka

6. Collaboration Work(s)

Institute collects blood samples from the newborn babies as part of country wide screening of neonatal congenital hypothyroidism program under the National ADP project 'Screening of Congenital Hypothyroidism in newborn babies (phase-2).'

7. Service Rendered and Revenue Income

Name of the service	No. of patient	Income
Patients service including Ultrasound and etc.	22881	11995200/-

INSTITUTE OF NUCLEAR MEDICINE & ALLIED SCIENCES (INMAS), FARIDPUR

Introduction

Institute of Nuclear Medicine & Allied Science (INMAS), Faridpur was established along with other three institute in Mitford, Commilla and Bogra as a common project. The institute is situated in the premises of Faridpur medical college hospital. The foundation stone was led on 15 Sept. 1995, construction was completed in early 1997 and the institute started running in Oct. 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. Services

- Render diagnostic and therapeutic service to the patients. A large number of patients attend the institute for different kinds of ultrasonogram, thyroid function studies, radioisotope scan and for estimation of different other hormones. The institute also render therapy for thyrotroxicosis and ca-thyroid patients.

2. Research and Development Work(s)

- Duplex study of carotid arteries in normal individuals to determine
- normal range and variations
- Study of ovulation by ultrasound in female infertility.
- Duplex study of pregnancy for early detection of IUGR.

3. Manpower Development and Training Program

- Training on "Public procurement processing and approval procedure", 26-28 Aug. 2019, BIM, Mirpur, Dhaka by Md Lutfor Rahman, Acc. officer, INMAS, Faridpur
- Training on "Dried Blood sample collection procedure for the congenital hypothyroidism screening for nurses/tecnologists", 18 Nov. 2019, NINMAS, Dhaka by Shahidul Islam Khan, SSA, INMAS, Faridpur
- Scientific training on "Practical works in the laboratory, Lab. precaution and accident management", 9-14 Nov. 2019 for officers and staffs of INMAS, Faridpur.

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

Name of the participant	Title of the event	Organizer	Date	Place
Dr S. K. Dey	Workshop on Obstetric Ultrasound: Triad and triump	INMAS, Dhaka	15 Jul. 2019	INMAS, Dhaka
Dr A. Khanam	Visiting expert assisted local education workshop and remote seminar on Nuclear Science	NINMAS, Dhaka	1-3 Dec. 2019	NINMAS, Dhaka

5. Service Rendered and Revenue Income

Name of the service	No. of patient	Income
Patients service including Ultrasound and Doppler, Scintigraphy, radioiodine therapy and hormons	18071	10380300/-

INSTITUTE OF NUCLEAR MEDICINE & ALLIED SCIENCES (INMAS), BOGURA

Objective/Introduction

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 Institutue is mainly involved with diagnosis and treatment of various human diseases using radiopharmaceuticals. Academic and research activities are also performed here. Gamma camera, thyroid uptake system, gamma counter, pterygium applicator, ultra sonogram and other associated ultra-modern equipments are available in this Institutue.

Activities

1. Manpower Development and Training Program

Title (of the event	Date	Place	No. of participant
Preliminary work to be done in case of accident/emergency in the laboratory	5 Oct. 2019	INMAS, Bogura	32
E-Filing	31 Oct. 2019	INMAS, Bogura	15
In House Training Course on Legal Basis For Radiation Protection in Nuclear Medicine Practices & Legal Basis For Radiation Protection in Nuclear Medicine Practices	27 Sept. 2019	INMAS, Bogura	5
In House Training Course on Assay Procedure& Assay Count	28 Aug. 2019	INMAS, Bogura	15
In House Training Course on The Government Servants Conduct Rules- 1979 and Pension & Gratuity	29 Aug. 2019	INMAS, Bogura	12
In House Training Course on the Staff for behavior Patients handling during delivery of Service	15 Sept. 2019	INMAS, Bogura	45
In House Training Course on Radioactive Waste Management & Clinical advancement in USG & Color Doppler	20 Oct. 2019	INMAS, Bogura	5

Title (of the event	Date	Place	No. of participant
In House Training Course on Serum Procedure & Collimators Description	15 Oct. 2019	INMAS, Bogura	14
In House Training Course on The Official Secrets Act.1923 & Government Travel Allowance	22/10/2019	INMAS, Bogura	15
In House Training Course on History of Nuclear Medicine in BD & Radiation Safety for the Patient and Occupational Worker	06 Nov. 2019	INMAS, Bogura	6
In House Training Course on Hypo/Hyper Patient& Crystal and Positioning Logic	07 Nov. 2019	INMAS, Bogura	17
In House Training Course on The Public Servants (Retirement) Act 1974 and (Retirement) Rules -1975	20 Nov. 2020	INMAS, Bogura	12
In House Training Course on Myocardial Perfusion Imaging & USG Of Genitourinary System	11 Dec. 2019	INMAS, Bogura	6
In House Training Course on TSH Level High/Low & Energy Discrimination and Plus Height analysis	17 Dec. 2019	INMAS, Bogura	20
In House Training Course on Retirement benefits and Eligibility conditions & Rules for receiving Pension	18 Dec. 2019	INMAS, Bogura	15
In House Training Course on Bone Scan- Differentiation Between Metastatic and Arthritic Changes & Overview on fetal Anomaly Scan	11 Jan. 2020	INMAS, Bogura	5
In House Training Course on LH/FSH & Collimator Resolution vs Distance	12 Jan. 2020	INMAS, Bogura	20
In House Training Course on 5-24 বৎসর চাকুরিকালের মধ্যে পেনশন প্রাপ্তির শর্ত ও পেনশনারদের প্রাপ্য বিভিন্ন ভাতা সংক্রান্ত	18 Jan. 2020	INMAS, Bogura	16
In House Training Course on Treatment of Thyrotoxicosis & An overview on Per-Vaginal Sonography	29 Feb. 2020	INMAS, Bogura	6
In House Training Course on FT4/ TSH Related & TG	15 Feb. 2020	INMAS, Bogura	20
In House Training Course on Different kinds of Leave Rules and The Provident Funds Act 1925	11 Feb. 2020	INMAS, Bogura	16
In House Training Course on Biological Effect of Lionizing Radiation & New Research Topic in INMAS, Bogura	15 Mar. 2020	INMAS, Bogura	6
In House Training Course on Introduction Reading (QC) & Kit Preparation/Hit Storage	18 Mar. 2020	INMAS, Bogura	20
In House Training Course on Transfer Provisions and Jobs (Salaries & Allowances) Order 2015	19 Mar. 2020	INMAS, Bogura	16

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

Name of the Participant	Title of the event	Organizer	Date	Place
Dr. M. A. Mamun	Obstetric Ultrasound: Triad & Triump	INMAS, Dhaka	15 Jul. 2019	Dhaka
Dr. S. A. howdhury	PPR-2008 and public procurement management	BIM, Dhaka	15- 26 Sept. 2019	Dhaka
M. N. Huda	Training Course on PPR-2008 and public procurement management	TI, AERE	20 - 31 Oct. 2019	TI, AERE
M. F. Hossin	RCA/KAERI Introductory Training Course on Radiation Technology and its Applications	KAERI, Korea	28 Oct. - 8 Nov. 2019	Korea
	Reactor Engineering Course at BAEC (RECB-8)-2020	TI, AERE	09 - 27 Feb. 2020	TI, AERE

Name of the Participant	Title of the event	Organizer	Date	Place
M. J. Alam	Dried Blood Spot (DBS) Sampling (Heel prick & Cord Blood) Procedure for the Screening of Congenital Hypothyroidism in Newborn Babies	NINMAS, Dhaka	03 Nov. 2019	Dhaka
Dr. S. A. Chowdhury and Dr. S. Sharmin	2019 Bangladesh KOICA Workshop on Clinical Nuclear Medicine	NINMAS, Dhaka	1-3 Dec. 2019	Dhaka
M. A. Ali	FTC on Environ. Radioactivity Monitoring	TI, AERE	12 - 16 Jan. 2020	TI, AERE
S. Parvin	E-Book preparation	BANSDOC, Dhaka	03 Mar. 2020	Dhaka
Prof. M. A. Awal	Participated in the Monthly Coordination Meeting Through Video Conferencing	BAEC, HQ	20 May 2020	Dhaka

3. Service Rendered and Revenue Income

Name of service	No. of sample/patient	Income
Patient service	5855 Nos.	2964900/-
Sample analysis (including blood sample)	9523 Nos.	7053100/-
Total	15378 Nos.	10018000/-

INSTITUTE OF NUCLEAR MEDICINE & ALLIED SCIENCES (INMAS), CUMILLA

Introduction

Institute of Nuclear Medicine & Allied Sciences (INMAS), Comilla is established in 1996 which located at Cumilla Medical College Campus, Cumilla. This institute, provides diagnostic and therapeutic treatment service by using nuclear medicine technique, Ultrasound & Color duplex Scase of the Patients east part of Bangladesh covering Cumilla, Noakhali, Chandpur, Laxmipur, Feni Etc.

Activities

1. Academic

- Lecture delivered to 5th year under graduate level student on Nuclear Medicine of Cumilla Medical College
- Lecture delivered to 3rd-5th year student of Moinamoti Medical College (Pvt.)
- Arranged honorary training (6 Months) for 02 Doctors on nuclear medicine & Ultrasound.

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

Name of the Participant	Title of the event	Organizer	Date	Place
Dr. M. Reajul Islam	E-Nothi Training Programme	ICS	26 Feb. 2020	BAEC, HQ
	Workshop Cum Training Programme on Gynaecological & Obstetric Ultrasonography, Triad & Triumph	BAEC	15 Jul. 2019	INMAS, Dhaka

3. Others

Regularly follow up of thyroid patient.

4. Service Rendered and Revenue Income

Name of Service	No. of patient	Income
Patient Service (USG, Color Doppler, BMD, Therapy, Follow up Thyroid Scan, Renal Scan, Bone Scan, Anomaly Scan, Testicular Scan, Renogram/GFR, RIA etc.)	16091	10593700/-

INSTITUTE OF NUCLEAR MEDICINE & ALLIED SCIENCES (INMAS), COX'S BAZAR

Objective

- Nuclear science aims to contribute to overall socio-economic development though the peaceful use of nuclear energy and to achieve self-reliance by advancing technology
- Advancement of basic practical and advanced research programs based on nuclear science and technology in physical biological and engineering fields
- Development of skilled human resources in the field of nuclear science and technology
- Radiation safety practices
- Ensuring safety and peace full use of nuclear energy
- Expanded the use 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

1. Services

- Follow up of thyroid patients
- Radio Iodine Therapy
- Scintigraphy and Ultrasound
- RIA
- Field level application of Sterile Insect Technique (SIT) for suppression/control of blowfly, *Lucilia cuprina* infesting sun

2. Manpower Development and Training Program

Title of the event	Date	Place	No. of participant
In-house training course on office manners and general behavour	22-26 Sept. 2019	INMAS, Cox's Bazar	14

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

Name of the Participant	Title of the event	Organizer	Date	Place
Prof. Dr. M. S. Alam	Workshop on PET-CT	NINMAS	Oct. - 2019	NINMAS
M. Hossain	21st International biennial conference & AGM 2019	Zoological Society of Bangladesh	7-8 Dec. 2019	DU
Dr. F. Akter	Workshop on PET-CT	NINMAS	Oct. 2019	NINMAS
Dr. P. Podder	FTC on Nuclear and Radiological Emergency Preparedness	TI, AERE	24 Nov. - 05 Dec. 2019	AERE

4. Service Rendered and Revenue Income

Name of service	No. of patient/samples	Income
Patient service	3663	2120900/-
Sample analysis (including blood sample)	5568	
Total	9,231	21,20,900/-

III. ENGINEERING AND GENERAL SERVICES

ENGINEERING DIVISION (ED), 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 2400 MW Rooppur Nuclear Power Project (RNPP) at Pabna. Following activities have been performed by Engineering Division during 2019-2020 periods.

Activities

1. Contribution for implementing ADP projects (both completed and ongoing)

1.1 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 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.

1.2 Works 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.

1.3 Works for Planning, Designing, Estimating and Construction of eight new buildings 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, Gopalgonj, Pabna, Satkhira.

1.4 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 electrical works.

1.5 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.

1.6 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"

1.7 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), AERE"

1.8 Similar works contributed for the project "Establishment of Calibration and Quality Control Facilities for Radiotherapy, Diagnostic Radiology and Neutron".

2. Works accomplished under revenue budget

2.1 BAEC HQ, Dhaka

- Supplying of Furniture for Human Resources Division at BAEC, HQ
- Supplying and Replacing of lift Equipment for 2 lifts, at BAEC, HQ

- Supplying, installation Testing & Commissioning for 2.5 Ton Split Air Conditioner at BAEC, HQ
- Electrical Works for 300KVAR PFI System 1500KVA Sub-station] at BAEC, HQ
- Repair and Maintenance work for NSSSD, QMD, Engineering Division, Medical Clinic at BAEC, HQ
- Separation and Modification of Telephone and intercom distribution board at BAEC, HQ
- Vertical Extension Works [7th Floor and other related works] at BAEC, HQ
- Digital Topographical survey of BAEC, Housing, Banani and Digitalization of the old AERE master plan
- Supply, Installation, Testing & Commissioning of 5 [2.5x2] Ton split Air Conditioner at BAEC, HQ
- Renovation works of 2nd floor corridor at BAEC, HQ
- Supplying, fitting & Fixing Vertical Venetian Blinds of Physical Science Division at BAEC, HQ
- Supplying, Fitting and fixing office furnitures at chairman Office secretariat of BAEC, HQ
- Supplying, Testing and Printing of RFID Proximity Card at BAEC, HQ
- Supplying of Electrical Goods for BAEC, HQ
- Renovation/repair and maintenance work of room no 701 at BAEC, HQ.

2.2 BAEC housing colony, Banani, Dhaka

- Renovation/repair and Maintenance works of Boundary wall at BAEC Housing Colony, Banani
- Renovation/Repair and Maintenance works of Flat No HB-05 & 07 at BAEC, Housing Colony, Banani Dhaka
- Renovation/Repair and Maintenance works of Flat No D-10, ANNEX-05 & 09 at BAEC, Housing Colony, Dhaka
- Supply, Installation, Testing & Commissioning of Submersible Pump set and Related works at BAEC, Housing Colony
- Renovation/Repair and Maintenance works of Flat No D-10, ANNEX-05 & 09, Flat No: D-3, HB-9 & Pump House at BAEC, Housing Colony, Dhaka
- Renovation/repair and Maintenance works of C-06 and C-19 at BAEC, Housing Colony, Bananai, Dhaka
- Renovation/repair and Maintenance works of flat No: Servant Quarter 05 & waste and removing debris at BAEC, Housing Colony, Banani, Dhaka
- Renovation/Repair and Maintenance works of Flat No Annex-01, C-05, 16 & D-09 at BAEC Housing Colony, Dhaka
- Renovation/repair and maintenance of Flat No C-01, 10 & 11 at BAEC Housing Colony, Dhaka.

2.3 AERE and other campus of BAEC

- Supply, installation, testing and commissioning of outdoor LED Display Bill Board [18.5¢ x 13¢ aoorix] at AERE
- Construction of 2 Gates and Gate house in front near side of road adjacent to guest house) at BSMEC, Cox's Bazar.

2.4 NINMAS and INMAS(s)

- Renovation/repair and maintenance works at INMAS Mitford, Cumilla and Bogura old campus

3. Completed services

- Works contributing under the project "Modernization of Food and Radiation Biology Facilities" AERE, Savar are Planning, Designing, Estimating and supervision of vertical extension of old IFRB building and others related renovation works
- Rendered various services related to Planning, Designing, Drawing and Sanitation work (civil, electrical, mechanical & sanitary) at various divisions /facilities of BAEC HQ

- Rendered various services related to Planning, Designing, Drawing and Sanitation works (civil, electrical, mechanical & sanitary) at various facilities of Atomic Energy Researches Establishment, Savar
- Rendered various services related to Planning, Designing, Drawing, Sanitation works (civil, electrical, mechanical & sanitary) at various facilities of BAEC Housing Colony, Banani, Dhaka
- Performed Planning & designing services (civil, electrical, mechanical and sanitary) contributed to various facilities at Bangladesh Atomic Energy Regulatory Authority (BAERA)
- Performed Planning & designing services (civil, electrical, mechanical and sanitary) contributed to various facilities of Dhaka, Sylhet, Rajshahi, Chittagong, Dinajpur, Rangpur, Khulna INMAS
- Providing technical expert services in various Centers/institutes/different projects of BAEC and other National Projects outside BAEC like, Dept. of Environment, Commerce Ministry (Bangladesh Tread Portal Enhance Project), UGC and Science Museum.

4. Preparation of Development Project Pro-forma (DPP)

- Establishment of Calibration and Quality Control Facilities for Radiotherapy, Diagnostic Radiology and Neutron
- Establishment of Cyclotron & PET-CT at Institute of Nuclear Medicine & Allied Sciences, Mymensingh & Chittagong and Cyclotron facilities at Institute of Nuclear Medical Physics, AERE
- Balancing, Modernization, Refurbishment and Extension of Safety Systems of the 3 MW TRIGA Mark-II Research Reactor Facilities
- Construction of New Residential Buildings and Infrastructure Development of Existing Residential Area of Bangladesh Atomic Energy Commission

5. Manpower Development and Training Program

Title of the event	Date	Place	No. of participant
Best Practice	15 Jul. 2019	BAEC, HQ	42
Tender document Preparation and tender evaluation.	23 Jul. 2019	BAEC, HQ	19
Nothi Requisitions Form, Government letter, Nothi presentation, Send, Reserved and solution (Module -1)	16 Sept. 2019	BAEC, HQ	42
Public Services Rules (2018) (Module -1)	16 Sept. 2019	BAEC, HQ	42
Basic Construction Equipments (Civil/Module -1)	19 Sept. 2019	BAEC, HQ	23
Basic building Equipments (Mechanical/Module -1)	30 Sept. 2019	BAEC, HQ	19
Basic building Equipments (Mechanical-AC/Module -1)	30 Sept. 2019	BAEC, HQ	23
Construction Management Fundamentals/(Module -1)	Jul. 2019	BAEC, HQ	42
Construction Site Safety/Module -1	Aug. 2019	BAEC, HQ	42
Basic Building Equipments (Lift/M-3)	19 Sept. 2019	BAEC, HQ	23
Basic ICT Equipments (M-2)	28 Oct. 2019	BAEC, HQ	23
Pension and Gratuity (Module -1)	24 Oct. 2019	BAEC, HQ	42
Seniority Rules (Module -1)	24 Oct. 2019	BAEC, HQ	42
Basic ICT Equipments (Module -1)	28 Oct. 2019	BAEC, HQ	23
BAEC Services Rules (Module -1)	27 Nov. 2019	BAEC, HQ	42
Basic E-Tendering (Module -1)	27 Nov. 2019	BAEC, HQ	19
Basic E-Nothi (Module -1)	26 Dec. 2019	BAEC, HQ	42
Law of Information Rights.	26 Dec. 2019	BAEC, HQ	19
PPR Fundamentals (Module -1)	23 Dec. 2019	BAEC, HQ	19
PPR Fundamentals (Module -2)	23 Dec. 2019	BAEC, HQ	19
DPP Presentation (Module -2)	24 Dec. 2019	BAEC, HQ	19

6. Seminar/Symposium/Conference/Workshop/Training/Meeting Attended

Name of the Participant	Title of the event	Organizer	Date	Place
Engr. D. Saha	Basic Nuclear Orientation Course-2020	TI	15 Mar. 2020	TI, AERE
Engr. N. Ahmed	Basic Principle of WTO Agreements and Notification Requirements	WTO Cell, Ministry of Commerce	26-28 Nov. 2019	Ministry of Commerce
Engr. S. M. A. Hasan and Ar. L. T. Ankon	PPR-2008 Public Procurement Management	Training Institute	20-31 Oct. 2019	TI, AERE
M. Moniruzzaman	Effective Budget & Budgetary Control	BIM	19-23 Oct. 2019	Sobahanbagh, Dhaka
Engr. N. Ahmed	NSW vision Workshop	NBR, Dhaka	19-22 Oct. 2019	The Palace Resort, Habiganj
Engr. A. Helal, Engr. M. S. H. Chowdhury. Engr. M. Billah and Engr. R. A. Biswas.	Engineer Staff College (ESCB), Training Course	Training Manager, ESCB, Ramna, Dhaka	12 Jun. 2020	Ramna, Dhaka
Engr. D. Saha	PPR 2008 and Public Procurement Management	BIM	15-26 Sept. 2019	Sobahanbagh, Mirpur Road
Engr. S. M. A. Hasan and Ar. L. T. Ankon	Project Management	BIM	26-28 Sept. 2019	Sobahanbagh, Mirpur Road
Engr. N. Ahmed	Sampling Methodologies for Monitoring, Sustainable Development Goal Indicators	ISRT, DU	17-19 Dec. 2019	Dhaka University
Engr. A. M. A. Karim	Total Quality Management	BIM	29-31 Aug. 2019	Sobahanbagh, Mirpur Road
Engr. N. Ahmed and Engr. A. Helal	The development and upgrade the construction inspection and oversight programme	HRD, RNPP Bhaban	18-22 Aug. 2019	Ruppur NPP Bhaban, Dhaka
Engr. R. A. Biswas	Motivating People at Workplace	BIM	22-23 Jul. 2019	Sobahanbagh, Mirpur Road
Engr. R. A. Biswas and Engr. A. Helal	Advance Microsoft Excel	NAPD	07-28 Jul. 2019	Nilket, Dhaka
Engr. M. Billah. and R. A. Biswas	Electronic Government Procurement(e-GP) System	TI, AERE	31 Mar. - 04 Apr. 2019	AERE, Savar
Ar. Mst. R. Parveen	The Pre-shipment Visit for the Dual Head SPECT	USA	15-21 Dec. 2019	USA
Engr. M. O. Islam	The Scientific Visit on spent fuel storage facility, Oarai Research and Development Center JAEA	Japan	16-20 Dec. 2019	Japan
Engr. D. Saha	Training Course on Implementing the systematic Approach to Training in New Nuclear Power Programmes	Japan	25 Nov. - 06 Dec. 2019	Japan
Engr. A. M. A. Karim	Nuclear Technology Seminar JFY 2019	Japan	30 Sept. - 25 Oct. 2019	Japan
Engr. D. Saha	KINS International Workshop	Korea	23-31 Oct. 2019	Korea

Name of the Participant	Title of the event	Organizer	Date	Place
Engr. N. Ahmed	IAEA/RCA [RAS/7030] Final Project Assessment Meeting	Mongolia	23-27 Sept. 2019	Mongolia
Engr. Q. M. S. Alif	Pilot Training Course on Nuclear, Supply Chain Management and Procurement, 2019	Vienna, Austria	30 Sept. - 04 Oct. 2019	Vienna, Austria
Engr. A. Sarder	Technical Meeting on Digital Instrumentation and Control Systems	Vienna, Austria	01-05 Jul. 2019	Vienna, Austria

ENGINEERING AND GERNERAL SERVICE (EGS) DIVISION, AECD

Objective

- Engineering and General Service Division provides engineering and technical services to research and development activities in the Atomic Energy Centre, Dhaka (AECD). This division has six sections: Electrical, Refrigeration & Air Conditioning System, Plumbing, Workshop, Glass Blowing, Utility & Civil Engineering section to support divisional activities. This division also provides all utility related service such as electricity, water supply, ventilation, air-conditioning system, civil works etc. through the respective sections.
- During the reporting period (01 July, 2018 - 30 June, 2019) this division received over 115 jobs requisition from different division of AECD, RNPP, BAEC HQ and AERE.

Activities

1. Electrical Section

- Completed 47 jobs for installation and repairing
- Completed 29 jobs for Administration, store and procurement
- Repair electricity line several times in Directors room, Accounts and library section
- Repair and set door lock, window curtain ring adjusted in library section
- Tube lights were replacement in various lab rooms, corridors and Director's room including boundary wall and drivers' room, canteen
- Light repair in ACL, Trace Analysis Lab.
- Blender machine repair in ACL lab.
- Replacement of combined switch in XRF laboratory
- Two fan repair in ACL lab.
- Repair, maintenance and replacement of light, fan repair and combined switch socket was used for Health Physics Division (HPD)
- Light and exhaust fan repair in NDT division
- Combined switch and tube lights replace in Electronics Division (ED)
- Electrical maintenance work done in Medical Physics and AFD lab.
- Two electrical maintenance work done in Plasma Physics division.

2. Refrigeration and Air-Conditioning System Section

- Completed 39 jobs. For installation, repairing and maintenance of Air-conditioners of AECD as well as BAEC head quarter building
- Total three AC were repaired in the TLD room, Main Lab and Divisional Head room in Health Physics Division (HPD) and total two AC were repaired in the NDT Division
- Total thirteen AC were repaired (i.e. gas charge, circuit, compressor, blower etc) for all Labs in the Chemistry Division
- Total fourteen AC were repaired in the Administration, Accounts, store and library section

- Two AC were repaired in the Solar Physics Division (SPD) and Three AC were repaired in the Material Science Division (MSD)
- Two AC were repaired in the Electronics Division (ED).

3. Plumbing Section

Completed 21 jobs. for plumbing

- Basin and water supply line repaired, toilet flash and low down repaired, Door lock repaired, Water purifier plant repaired in Chemistry Division
- Door lock repaired, window repaired, window glass repaired for sitting room in Administration
- Basin and water line repaired in Health Physics Division
- Bathroom sink repaired for Electronics Division
- Repaired the low down and pan commode for gent's toilet
- Repaired the toilet flash for Analytical Chemistry Laboratory
- Repair and maintenance gas line and knob were performed for Atmospheric and Environ. Lab in Chemistry Division
- A strong concrete basement made for drinking water tank under EGS supervision.

4. Workshop Section

- Metal display board preparation for Administration
- Made machine support stand for Electronics Division
- Made and adjust hardware for Chemistry Division
- Made a nameplate hole for Material Science Division.

5. Glass Blowing Section

Performed two glass related work for chemistry division and BUET MS research student.

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 works 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 e.g. designing, planning, installation, operation and maintenance of all facilities of AERE, the largest research complex of Bangladesh Atomic Energy Commission (BAEC). Power supply system, gas 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

Repair & Maintenance and Renovation Works

- Supplied drinking water which is used in different Institute of the office side and residential area of AERE colony
- Repaired colony side 25 HP centrifugal pumps 3A, 3B, 3C & 3D
- Repaired office side 25 HP centrifugal pumps 2A & 2B
- Repaired office side 41HP submersible pump-motor including of spare parts, consumable materials servicing works at AERE
- Installation & modification works of ball cock for overhead water tank of office building at AERE, Savar

- Installation & modification of underground water pipe line for SIU at AERE, Savar, Dhaka
- Repaired & maintained underground water pipeline in AERE
- Cleaning and washing works of underground and overhead water tank at AERE campus
- Operated & maintained deep-well turbine pump & other pumps regularly
- General servicing around 40 Nos. of window & split type A/C in all institutes of AERE
- Repaired 25 Nos. of window & split type AC at INST, IFRB, TI, IE, ICS, VIP guest house, TAD, Cafeteria, INM & CAD building
- Replaced around 15 Nos. of blowers of window & split type, 25 Nos. of compressor of AC & refrigerator and repaired around 20 Nos. of refrigerator & fridge in different institutes of AERE
- Repaired other refrigeration systems (Cooling incubator, Dehumidifier etc.) at AERE
- Operated & maintained the central AC of INST auditorium
- Overhauling, repairing, servicing, testing and commissioning of 133 ton once thru' air conditioning, ventilation and exhaust system at RIPD, INST, AERE
- Installation and refilling works of fire extinguisher at AERE
- Electrical repair & maintenance work of research laboratory related machineries
- Electrical repair & maintenance work of security lights, laboratory lights etc at AERE office and residential colony
- Painted fan, gates and other equipment in AERE office & residential area
- Renovation, repair & maintenance work of VIP guest house with necessary modification at AERE
- Repair and maintenance work of quarter no. C-1/3, C-1/6, C-2/5,C-3/4,C-3/7,C-3/8, D-1/4, D-2/1, D-2/3, D-2/4, D-2/8, F-1/2, F-1/9, F-1/10, F-1/13, F-1/14, F-2/6, F-2/8, F-3/2, F-3/3, F-3/4, F-3/7, F-3/18, E-1/6, E-1/10, E-2/1, E-2/5, E-2/6, E-2/9, E-2/14, E-2/15, E-2/16, E-3/5, E-3/6, E-3/11, E-3/12, E-3/18, E-3/20, E-4/2, E-4/4, E-4/6, E-4/11 and E-4/18 at AERE
- Repair, maintenance work for INST/IFRB/CAD/TI/CAD building at AERE
- Repair of furniture with supplying materials at TI, AERE
- Making of wood box for water bottle sample collection at IHD, INST at AERE
- Making steel rack for laboratory research work of NRCD- INST at AERE
- Making bill board for IE at AERE
- Repair & maintenance work of window glass, door lock, frame & shutter for different Institutes of AERE

IV. INTERNATIONAL AFFAIRS DIVISION (IAD), 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 organisations 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 personals. In the financial year 2019-2020, IAD has processed nominations of 328 participants for various international Program 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.

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 2019-2020, IAD worked for Ten (10) 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 Nineteen (19) RCA projects covering different nuclear fields namely- Agriculture, Human Health, Industry, Environ. 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 Eight (38) 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 Dept. of the Hospitals Centre for Woman and Child Health, are involved with CRP's.

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, Kazakistan, Australia, Bangladesh, China, Indonesia, Republic of Korea, Malaysia, Philippines, Thailand and Viet Nam. In the financial year 2019-2020, IAD made liaison for a number of Seven (7) FNCA projects. In total Five (5) participants participated in various international Program in the said financial year.

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 or 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 Courses (FTCs) and Instructor Training Courses (ITCS)

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 Seventy One participants are trained in different areas of nuclear science and technology. In addition Five (5) participants for ITC have completed the corses in Japan.

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 Jul. 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), HQ

Introduction

Nuclear Power and Energy Division (NPED) is one of the most important divisions of Bangladesh Atomic Energy Commission (BAEC). NPED is playing a vital role to implement the nuclear power program in Bangladesh. From the very beginning of this division, it has been working in the research and development works for the implementation of nuclear power program in Bangladesh. NPED is playing a role of liaison among BAEC, Ministries of the Government of Bangladesh, International Atomic Energy Agency (IAEA) and Vendor Countries to coordinate and implement the fast track project of the Government of Bangladesh titled “Construction of Roopppur Nuclear Power Plant (RNPP) Project”. NPED is also playing an important role to select another site for nuclear power plant with the project titled "Probable site selection for construction of nuclear power plant in the southern part of Bangladesh".

Activities

1. Construction of Rooppur NPP

Rooppur NPP, Bangladesh’s maiden nuclear power generation facility, observed the second anniversary of its First Concrete Day (FCD) on Nov. 30, 2019. On that day in 2017, Hon’ble Prime Minister of the Government of Bangladesh Sheikh Hasina poured the first concrete into the reactor base of Unit-1 of Rooppur NPP.

The Hon'ble Deputy Director General (Nuclear Energy) of IAEA Mr. Mikhail Chudakov visited Bangladesh from 1st Feb. to 5th Feb., 2020. He visited Rooppur NPP Project Site and expressed his satisfaction over the progress of the construction of Rooppur Nuclear Power Plant Project. He met with the Chairman of BAERA, Chairman of BAEC, Senior Secretary of Ministry of Science and Technology and Secretary of Ministry of Foreign Affairs. He also met with Hon’ble Minister, Ministry of Science and Technology. Besides, He provided a Speech to BAEC officials, university teachers and students of nuclear science & engineering.

The Hon'ble Minister of Ministry of Planning and the Hon'ble Minister of Ministry of Science and Technology expressed satisfaction on the project implementation progress by visiting the Rooppur Nuclear Power Plant Project site on 9th Mar., 2020.

The soil stabilization works under the foundations of all buildings/facilities, four cooling towers of Unit-1 and Unit-2 and also under foundations of other complex and safety related facilities/infrastructures have already been completed as per the design requirements and the compliances of the provision of BAERA. The construction of foundations (3.00-meter-thick) of the reactor buildings of Unit-1 and Unit-2, at the elevation of -8.45m to -5.45m, are completed. The construction of foundations of all other buildings/facilities of Unit-1 and Unit-2 and all civil works below ceiling level 0.000m (19.15m MSL) for the reactor buildings have been completed. The molten core catcher at Unit-1 and Unit-2 are installed as per design requirements. In case of Unit-1, console truss has been installed and concreting of console truss and installation of dry shielding with serpentine concrete has been completed. The reinforcement and concreting work of cavity wall is completed at elevation of +11.3m & inside Reactor Cavity wall Guide plate, Thermal Insulation, Support Truss & thrust Truss installation is completed. The construction of Inner Containment wall up to +20.42 m is completed and concreting is done till +18.5m.

In case of Unit-1, the construction of 3rd tier segment of Inner containment wall has started and 12 blocks were constructed from +20.43 m to +34.05 m height. Concreting work is finished in 11 blocks out of 12 blocks from +19.00 m to +28.00 m height. In Outer Containment, Reinforcement completed till +8.35m (thickness is 500mm) and concreting work is finished in 04 sections out of 05 sections. Inside UKA rooms of reactor Building Component Cooling Circuit Heat exchanger & Primary circuit emergency and planned cool down and fuel pool cooling have been installed. The construction of auxiliary reactor building and other facilities of Unit-1 are completed up to +0.00 level. The reinforcement work of inner wall of auxiliary reactor building and other parts has completed up to +4.75 m & concreting work is currently ongoing. The outer wall of auxiliary reactor building are completed up to 4.75m. The construction of RCP Component cooling plate heat exchanger, FFT tank, Montejus tank, Active sewerage tank, Boron Water Collection Tank, Controlled Leak Tank, Decanted Fluid tank, Fire fighting water collection & checkup Tank installation in Reactor auxiliary building are completed. The foundation and reinforcement work of turbine building has completed up to 0.00 m. Among 175 inner columns, 35 inner columns were constructed up to -1.05m and 23 inner columns were constructed up to -3.06m. And out of 48 nos. of Turbo-Generator (TG) columns, 40 has been completed at -2.03m elevation & TG beams & slab is completed at elevation -2.117 m & -1.47m.

In case of Unit-2, the construction of 2nd tier segment of Inner containment wall has started. In 2nd tier, 12 Mounting blocks were installed from elevation +6.43m to +20.43m. Concreting work is finished from 0.00 m to +5.53 m height. Outer Containment reinforcement installation work is ongoing till +8.35m (thickness is 500mm) (50% reinforcement work is finished). Inside UKA rooms of reactor Building Component Cooling Circuit Heat exchanger & Primary circuit emergency and planned cool down and fuel pool cooling has been installed. The construction of physical infrastructure of Reactor building has completed up to 0.00 m and the reinforcement of Adjacent structure of Internal wall has completed up to +4.75 m. And Reactor Cavity wall is completed till +11.3m elevation. The foundation and reinforcement of Auxiliary reactor building has completed up to 0.00 m and concreting work is 50% finished. Core catcher installation is completed till cantilever truss & inside Reactor Cavity Dry shielding, Guide plate, Support Truss installation is completed till +11.10m. The construction of RCP Component cooling plate heat exchanger, FFT tank, Montejus tank, Active sewerage tank, Boron Water Collection Tank, Controlled Leak Tank, Decanted Fluid tank, Firefighting water collection & checkup Tank installation in Reactor auxiliary building are completed. The foundation and reinforcement work of turbine building has completed up to 0.00 m & total 48 nos. of TG columns has been completed.

The construction of Jetty facilities is completed and currently soil stabilization work at water intake structure is ongoing. In addition, total 41 facilities/buildings along with 25 various water supply network system are constructed at the Construction Assembly Base-2. Construction works of several common facilities, namely-health physics laboratory, shelter buildings, training centre, radioactive waste management facility, fresh fuel storage facility, diesel power station, Controlled access area workshop, Administrative Building, Engineering & personnel amenity Building, Canteen building, Demineralization Plant Building, Chilling machine Building etc. are in progress. The quality of the work is ensured based on Quality Assurance programs developed on the basis of International and Russian normative documents.

In the scope of the General Contract, to construct the Rooppur Nuclear Power Plant, the work on manufacturing necessary equipments is going on in different manufacturing companies appointed by JSC

Atomstroyexport. The single-source manufacturer of nuclear island equipment for Rooppur NPP is Atomenergomash, the mechanical-engineering division of the State Corporation Rosatom is presently producing reactor vessels, steam generators, main circulation pumps for Roopppur NPP. Atomenergomash will also supply all the auxiliary equipments such as high-pressure heaters, moisture separator-reheater, pumping equipment, a set of pipeline fittings and a set of pipelines for the technological systems of the turbine unit for the Rooppur NPP. The other Long-term Manufacturing Equipment (LTME) such as steam turbine (complete set), emergency core cooling system, automated process control system, passive core flooding system hydro accumulator, full scale analytical simulator are being manufactured in different facilities in Russian Federation. Some of the LTMEs and components of the LTMEs, namely embedded parts of main lock and emergency lock, horizontal and vertical tendon trumplates, shelf metal rack, reactor cavity embedded parts, cantilever truss, guide plate, upper unit support, core barrel support, pressure relief tank have been transported to the construction site. Besides the LTME equipment, huge number of industrial equipment are being supplied by the General Contractor for Rooppur NPP. In this respect, necessary number of signing of readiness protocol, approval of quality plan and closing of control point have been done and the inspection activities on behalf of the Customer is going on. As per General Contract for Rooppur NPP construction, the Russian side is providing training for operational and maintenance personnel of Rooppur NPP.

The experts of India are providing consultancy services within the framework of the Rooppur NPP project. Indian experts provided consultancy services to the construction of 'Rooppur NPP' during this period in different field such as Management of NPP Construction and Erection works for RNPP; Civil construction related design and documentation review, quality control and non-conformance management for RNPP; Construction of Cooling Tower and Cooling Water Intake Structure for RNPP; Review of Documentation of Commissioning and Readjustment work for RNPP; Quality Assurance during Erection, Installation and Commissioning of the Equipment for Roooopur NPP; and Conformity Assessment and Monitoring of Manufacturing of Equipment for Rooppur NPP.

2. Site Selection of 2nd NPP

Under the project titled "Probable site selection for construction of nuclear power plant in the southern part of Bangladesh", Center for Environ. Geographic Information Services (CEGIS) was appointed to perform comparative analysis of fifteen preliminary sites data & information. According to the decision of the technical committee and PIC meeting in the light of the report submitted by CEGIS (1) Nishanbari (East), Taltoli Upazila, Barguna; (2) Kumirmara and Padma mouzas, Sadar Upazila, Barguna (3) Nishanbari (West), Taltoli Upazila, Barguna; (4) Char Montaz, Rangabali Upazila, Patuakhali; and (5) Moudubi, Rangabali Upazila, Patuakhali sites are identified as primarily. Besides, BAEC has appointed Dept. of Disaster Science and Management, University of Dhaka to perform survey of geological and geophysical works at these places. On the other hand, work order has been issued to Bangladesh University of Engineering to provide seismological and tectonic survey services. The Institute of Water Modeling (IWM) has appointed to provide surface water hydrological and ground water hydrological services. These organizations are in the final stage of their field- level activities.

3. Manpower Development and Training Program

Title of the event	Date	Place	No of participants
Orientation and Beginner's Training Course for Newly Recruited Officers (1st Group), Construction of Rooppur Nuclear Power Plant Project	10 - 13 Sept. 2019	RNPP Site Office	80
Orientation and Beginner's Training Course for Newly Recruited Officers (1st Group), Construction of Rooppur Nuclear Power Plant Project	18-21 Nov. 2019	RNPP Site Office	80
PC Based VVER-1200 Simulator Training	21-23 Jan. 2020	AECD	18
Orientation and Beginner's Training Course for Newly Recruited Officers, Construction of Rooppur Nuclear Power Plant Project	23-27 Feb. 2020	RNPP Site Office	80

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

Name of the participant	Title of the Event	Organizer	Date	Place
Dr. M. S. Akbar	Composition of the 2nd Meeting of the Fount Committee on Peaceful uses of Nuclear Energy Between Bangladesh and India	BAEC	22-24 Jul. 2019	India
	Visit to Russian Federation	BAEC	26-31 Aug. 2019	Russian Federation
	63rd IAEA General Conference	BAEC	16-20 Sept. 2019	Vienna, Austria
	Joint Training Advisory Commission (JTAC) Hold Points Inspection	RNPP Project	10-12 Nov. 2019	Russian Federation
	5th Joint Coordination Committee (JCC)	RNPP Project	13-15 Nov. 2019	Russian Federation
	National Conference on Electronics and Informatics	BES and BAEC	4-5 Dec. 2019	AECD
	Life time Nuclear Fuel Supply Contract Negotiation Meeting	BAEC	17-28 Feb. 2020	Russian Federation
	Manufacturing Activities of the Long Term Manufacturing Equipment (LTME) for the RNPP	RNPP Project	22-29 Feb. 2020	Russian Federation
	International Conference on Physics	BPS	5-7 Mar. 2020	Dhaka
Dr. M. Z. Hassan	Inspection of the Manufacturing of LTME and Milestone Achievement for the construction of Rooppur Nuclear Power Plant	RNPP Project	26 Jun.-18 Jul. 2019	Russian Federation
	Inspection of the Manufacturing of LTME and Milestone Achievement for the construction of Rooppur Nuclear Power Plant	RNPP Project	25 Sept.-10 Oct. 2019	Russian Federation
	Joint Coordination Committee Meeting and Pre-review of Documentation for the construction of Rooppur Nuclear Power Plant	RNPP Project	10-30 Nov. 2019	Russian Federation
	5th Joint Coordination Committee (JCC)	RNPP Project	13-15 Nov. 2019	Russian Federation
	Review and finalization of appendix-10, Achievement of Milestones of LTME	RNPP Project	18-27 Dec. 2019	Russian Federation
	Life time Nuclear Fuel Supply Contract Negotiation Meeting	BAEC	17-28 Feb. 2020	Russian Federation
M. H. Rahman	Attend the Inspection of verification testing of Mathematical Model of FFS & AS for the Construction of Rooppur Nuclear Power Plant	RNPP Project	15 -26 Jul. 2019	Russian Federation
	Joint Training Advisory Commission (JTAC) Meeting	RNPP Project	5-12 Nov. 2019	Russian Federation
	5th Joint Coordination Committee (JCC)	RNPP Project	13-15 Nov. 2019	Russian Federation
	Life time Nuclear Fuel Supply Contract Negotiation Meeting	BAEC	17-28 Feb., 2020	Russian Federation
Engr. M. Hossain	Inspection of the Manufacturing of LTME for the construction of Rooppur Nuclear Power Plant	RNPP Project	21 Aug.-14 Nov. 2019	Russian Federation
	Inspection of the Manufacturing of LTME for the construction of Rooppur Nuclear Power Plant	RNPP Project	20 Feb.-20 May 2020	Russian Federation

Name of the participant	Title of the Event	Organizer	Date	Place
Dr. M. Khalaquzzaman	Inspection of the Manufacturing of LTME for the construction of Rooppur Nuclear Power Plant	RNPP Project	18 Nov. 2019-17 Feb. 2020	Russian Federation
Dr. Engr. M. A. Razzaque	Technical Meeting on Sitting for Nuclear Power Plants	IAEA	15-18 Oct. 2019	Vienna, Austria
	Technical Meeting on Topical Issues in the Development of Nuclear Power Infrastructure.	IAEA	28-31 Jan. 2020	Vienna, Austria
Dr. A. F. M. M. Rahman	Inter-regional Training Course on Sitting for Nuclear Power Plants	*NPP project site	22-26 Jul. 2019	Vienna, Austria
	Technical Meeting on Siting for Nuclear Power Plants	IAEA	15-18 Oct. 2019	Vienna, Austria
	Technical Meeting on Challenges in New Build Projects in Countries with Nuclear Power programs	IAEA	13-15 Nov. 2019	Vienna, Austria
Dr. M. K. Hossain	Group Scientific visit to training centre for training management developing education and training methodology	IAEA TC	01-05 Jul. 2019	Russian Federation
	To display the activities of Rooppur Nuclear Power Plant Project, research activities and others in the exhibition stall of 63rd IAEA General Conference	RNPP Project	16-20 Sept. 2019	Vienna, Austria
	Joint Training Advisory Commission (JTAC) Meeting	RNPP Project	5-12 Nov. 2019	Russian Federation
	Joint Training Advisory Commission (JTAC) Meeting	RNPP Project	26 Jan.-01 Feb. 2020	Russian Federation
A. Chakraborty	To display the activities of Rooppur Nuclear Power Plant Project, research activities and others in the exhibition stall of 63rd IAEA General Conference	RNPP Project	16-20 Sept., 2019	Vienna, Austria
	5th Joint Coordination Committee (JCC)	RNPP Project	13-15 Nov. 2019	Russian Federation
	Life time Nuclear Fuel Supply Contract Negotiation Meeting	BAEC	17-28 Feb. 2020	Russian Federation
	Manufacturing Activities of the Long Term Manufacturing Equipment (LTME) for the RNPP	RNPP Project	22-29 Feb. 2020	Russian Federation
Dr. S. M. Rana	Inspection of the Manufacturing of LTME for the construction of Rooppur Nuclear Power Plant	RNPP Project	10 Jul.-10 Oct. 2019	Russian Federation
	Inspection of the Manufacturing of LTME for the construction of Rooppur Nuclear Power Plant	RNPP Project	1 Feb.-1 May 2020	Russian Federation
S. Sardar	Inspection of the Manufacturing of LTME for the construction of Rooppur Nuclear Power Plant	RNPP Project	20 May-13 Aug. 2019	Russian Federation
M. Aliuzzaman	Interregional Group Scientific Visit on Licensing of Nuclear Power Plants	IAEA	2-6 Sept. 2019	Russian Federation
G. M. B. Uddin	Korean Nuclear Society Autumn Meeting	KNS	24-25 Oct. 2019	Korea
A. Begum	Communication with the public and visit to public information centre in Russia	IAEA	17 Jun.-19 Jul. 2019	Russian Federation
S. Alam	Technical Meeting on Technical and Operational issues Related to the Transportation if High-	IAEA	24-26 Sept.	Vienna,

Name of the participant	Title of the Event	Organizer	Date	Place
	burnup and Irradiated Mixed Oxide Fuels and the Transportability of Long-Term Stored Spent Fuel		2019	Austria
S. Karmaker	Inter-regional Training Course on Sitting for Nuclear Power Plants	*NPP Project site	22-26 Jul. 2019	Vienna, Austria
K. M. J. U. Rumi	National Conference on Electronics and Informatics	BES and BAEC	4-5 Dec. 2019	AECD
	International Conference on Physics	BPS	05-07 Mar. 2020	Dhaka
M. A. Huq	Inspection of the Manufacturing of LTME for the construction of Rooppur Nuclear Power Plant	RNPP Project	21 Aug.-14 Nov. 2019	Russian Federation
	National Conference on Electronics and Informatics	BES and BAEC	4-5 Dec. 2019	AECD
	Inspection of the Manufacturing of LTME for the construction of Rooppur Nuclear Power Plant	RNPP Project	03 Mar.-20 May 2020	Russian Federation
N. R. Kundu	Inspection of the Manufacturing of LTME for the construction of Rooppur Nuclear Power Plant	RNPP Project	15 Aug.-15 Nov. 2019	Russian Federation
	International Youth Nuclear Congress	IYNC	08-13 Mar. 2020	Australia
A. Sharmin	Fellowship Program on Development of e-Learning Materials	IAEA	21 Oct.-15 Nov. 2019	Thailand
	Inspection of the Manufacturing of LTME for the construction of Rooppur Nuclear Power Plant	RNPP Project	18 Nov. 2019-17 Feb. 2020	Russian Federation
M. O. Faruk	National Conference on Electronics and Informatics	BES and BAEC	4-5 Dec. 2019	AECD
	International Conference on Physics	BPS	5-7 Mar. 2020	Dhaka
B. N. Sattar	15th Joint ICTP-IAEA Nuclear Knowledge Management School	ICTP	5-9 Aug. 2019	Trieste, Italy
	Inspection of the Manufacturing of LTME for the construction of Rooppur Nuclear Power Plant	RNPP Project	15 Aug.-15 Nov., 2019	Russian Federation
M. R. Amin	Inspection of the Manufacturing of LTME for the construction of Rooppur Nuclear Power Plant	RNPP Project	8 Apr.-31 Jul. 2019	Russian Federation
	Inspection of the Manufacturing of LTME for the construction of Rooppur Nuclear Power Plant	RNPP Project	29 Oct.-20 Jan., 2019	Russian Federation
S. Ahmed	Communication with the public and visit to public information centre in Russia	IAEA	17 Jun.-19 Jul. 2019	Russian Federation

*****Probable site selection for construction of NPP in the southern part of Bangladesh Project

5. Stakeholder Meeting

- A meeting convened by the Member Engineering for discussion in related to fill-up Questionnaire Form sent by Dept. of Safeguards of IAEA, was held on 4 Jul. 2019 in Rooppur NPP Bhavan, 4 Kazi Nazrul Islam Avenue, Shahbagh, Dhaka
- A working meeting of the NDT Division of the Bangladesh Atomic Energy Commission regarding radiographic tests and other NDT tests in related to the construction of Rooppur Nuclear Power Plant, was held on 7 Jul. 2019 in Rooppur NPP Bhavan, 4 Kazi Nazrul Islam Avenue, Shahbagh, Dhaka
- A meeting convened by the Member Engineering to evaluate the training documents sent by Atomstroyexport according to the Appendix-14 of General Contract, was held from 9 - 11 Jul. 2019 in Rooppur NPP Bhavan, 4 Kazi Nazrul Islam Avenue, Shahbagh, Dhaka

- A meeting convened by the Member Engineering to review the Work Execution Plan of the sent Package 2018.11 under General Contract of Construction of Rooppur Nuclear Power Plant, was held on 16 Jul. 2019 in Rooppur NPP Bhavan, 4 Kazi Nazrul Islam Avenue, Shahbagh, Dhaka
- A joint meeting of the Joint Training Advisory Commission (JTAC) between Bangladesh and the Russian Federation convened by the Member Engineering for the quality and successful implementation of manpower training under Appendix 14 of General Contract, was held from 28 Jul. - 1 Aug. 2019 in Rooppur NPP Bhavan, 4 Kazi Nazrul Islam Avenue, Shahbagh, Dhaka
- A meeting convened by the Director Engineering to review and approval of Working Documents of sent Package 2019.01-2019.06 under the General Contract of Construction of Rooppur Nuclear Power Plant, was held from 4- 7 Aug. 2019 in Rooppur NPP Bhavan, 4 Kazi Nazrul Islam Avenue, Shahbagh, Dhaka
- A meeting convened by the Member Engineering to determine the commission rate for the completion of custom clearance activities at Rooppur NPP Customs Station and Hazrat Shahjalal International Airport for imported Equipments/Goods of the construction of Rooppur Nuclear Power Plant, was held on 7 Aug. 2019 in head office, BAEC
- A meeting convened by the Member Engineering to review and to make recommendations for the achievement of the milestone of Long Term Manufacturing Equipment (LTME) under the Construction of Rooppur Nuclear Power Plant Project, was held 24 Aug. 2019 in Rooppur NPP Bhavan, 4 Kazi Nazrul Islam Avenue, Shahbagh, Dhaka
- A meeting convened by the Project Director on project implementation progress, work allocation and software based file management systems, was held on 24 Aug. 2019 in Rooppur NPP Bhavan, 4 Kazi Nazrul Islam Avenue, Shahbagh, Dhaka
- A meeting convened by the Director Engineering to review and approval of Working Documents of the sent Package 2019.01-2019.06 under the General Contract of Construction of Rooppur Nuclear Power Plant, was held from 25-26 Aug. 2019 in Rooppur NPP Bhavan, 4 Kazi Nazrul Islam Avenue, Shahbagh, Dhaka
- A meeting on Incoming Inspection of various equipments at Construction of Rooppur Nuclear Power Plant Project site, was held from 26 - 28 Aug. 2019 in Rooppur NPP Bhavan, 4 Kazi Nazrul Islam Avenue, Shahbagh, Dhaka
- A meeting convened by the Director QMD to evaluate Technical and Shipping Documentation of various equipments for Construction of Rooppur Nuclear Power Plant Project Site was held from 11 - 12 Sept. 2019 in Rooppur Project Site Office, Rooppur, Ishwardi, Pabna
- A bilateral meeting was held between the Hon'ble Director General, Rosatom State Corporation and the Hon'ble Minister, Ministry of Science and Technology in related to the implementation of the Construction of Rooppur Nuclear Power Plant Project, was held on 16 Sept. 2019 in Vienna
- A bilateral meeting was held between the Hon'ble Director General, Rosatom State Corporation, the Hon'ble Chairman of the Dept. of Atomic Energy, India and the Hon'ble Minister, Ministry of Science and Technology in related to the consultancy services of Indian experts for the implementation of the Construction of Rooppur Nuclear Power Plant Project, was held on 17 Sept. 2019 in Vienna
- A meeting convened by the Member Engineering to review various Management Procedure Documents of the Construction of Rooppur Nuclear Power Plant Project, was held from 25 - 26 Sept. 2019 in Rooppur NPP Bhavan, 4 Kazi Nazrul Islam Avenue, Shahbagh, Dhaka
- A meeting convened by the Member Engineering to evaluate training documents related to manpower training of Rooppur Nuclear Power Plant sent by Atomstroyexport according to Appendix-14 of General Contract was held from 30 Sept. – 3 Oct. 2019 in Rooppur NPP Bhavan, 4 Kazi Nazrul Islam Avenue, Shahbagh, Dhaka
- A meeting convened by the Member (Engineering) to evaluate the Construction of Rooppur Nuclear Power Plant Project Planning and Performing the Quality Inspection of Construction and Erection Works and Non-conformance Management during construction of Rooppur NPP (Further Procedure) Evaluation, was held from 2 - 3 Oct. 2019 in Rooppur NPP Bhavan, 4 Kazi Nazrul Islam Avenue, Shahbagh, Dhaka

- A meeting convened by the Project Director to discuss on Emergency Alarming System of Construction of Rooppur Nuclear Power Plant Project was held from 5 - 6 Oct. 2019 in Rooppur NPP Bhavan, 4 Kazi Nazrul Islam Avenue, Shahbagh, Dhaka
- A meeting convened by the Director QMD on Incoming Inspection of various equipments and review of various documents of Construction of Rooppur Nuclear Power Plant Project, was held from 7 - 9 Oct. 2019 in Rooppur NPP Bhavan, 4 Kazi Nazrul Islam Avenue, Shahbagh, Dhaka
- The 21st Coordination meeting was convened by the chairman of Bangladesh Atomic Energy Commission between the Russian contractor Atomstroyexport and the BAEC to resolve urgent issues for the smooth implementation of Construction of Rooppur Nuclear Power Plant Project, was held on 20 Oct. 2019 in Rooppur NPP Bhavan, 4 Kazi Nazrul Islam Avenue, Shahbagh, Dhaka
- A meeting convened by the Member Engineering to review the information obtained from the Preliminary Survey of the Emergency Alarming System of the Construction of Rooppur Nuclear Power Plant Project was held on 20 Oct. 2019 in Rooppur NPP Bhavan, 4 Kazi Nazrul Islam Avenue, Shahbagh, Dhaka
- The 16th meeting convened by the Chief Coordinator of SDG to the Prime Minister's Office on monitoring the smooth implementation of Rooppur Nuclear Power Plant project, was held on 27 Oct. 2019 at Rooppur Project Site Office, Rooppur, Ishwardi, Pabna
- The 5th preparatory meeting of the Joint Coordination Committee formed between Bangladesh and the Russian Federation for the implementation of the Rooppur Nuclear Power Plant project, was held from 13 - 15 Nov. 2019 at the conference room of the Ministry of Science and Technology. The meeting was convened by the Hon'ble Minister of the Ministry of Science and Technology
- A meeting convened by the Member Engineering to evaluate the training documents sent by Atomstroyexport according to Appendix-14 of General Contract, was held from 23 - 24 Nov. 2019 Rooppur NPP Bhavan, 4 Kazi Nazrul Islam Avenue, Shahbagh, Dhaka
- A joint meeting of the Joint Training Advisory Commission (JTAC) between Bangladesh and the Russian Federation convened by the Member Engineering for the quality and successful implementation of manpower training under Appendix 14 of General Contract was held from 25 - 28 Nov. 2019 in Rooppur NPP Bhavan, 4 Kazi Nazrul Islam Avenue, Shahbagh, Dhaka
- A meeting convened by the Secretary of Ministry of Science and Technology in related to the sub group of Grid System Development for the Construction of Rooppur Nuclear Power Plant Project was held on 28 Nov. 2019 in the meeting room of the Ministry of Science and Technology
- A meeting convened by the Member Engineering to sign the Milestones Certificate for Documentation Package No. 2019.07, 2019.08, 2019.09, 2019.10, 2019.11 and 2019.12 of the Construction of Rooppur Nuclear Power Plant Project was held on 4 Dec. 2019 in Rooppur NPP Bhavan, 4 Kazi Nazrul Islam Avenue, Shahbagh, Dhaka
- A meeting convened by the Director QMD for Incoming Inspection and Acceptance Inspection to achieve Milestone of LTME (Supply) and SU (Non-LTME) for the construction of Rooppur Nuclear Power Plant, was held from 10 -12 Dec. 2020 at Rooppur Project Site Office, Rooppur, Ishwardi, Pabna
- A meeting convened by the Member Engineering to achieve Non-LTME Milestone, was held on 18 Dec. 2019 in Rooppur NPP Bhavan, 4 Kazi Nazrul Islam Avenue, Shahbagh, Dhaka
- A Joint Training Advisory Commission (JTAC) meeting of Bangladesh side convened by the Member Engineering to achieve Milestone Certificate was held on 19 Dec. 2019 in Rooppur NPP Bhavan, 4 Kazi Nazrul Islam Avenue, Shahbagh, Dhaka
- A meeting convened by the Project Director on the progress of the current status of the licensing conditions of Unit-1 and Unit-2 of the Construction of Rooppur Nuclear Power Plant Project and what to do next were held on 19, 22 - 24 and 26 Dec. 2019 in Rooppur NPP Bhavan, 4 Kazi Nazrul Islam Avenue, Shahbagh, Dhaka
- A meeting convened by the Director QMD to achieve Milestone of LTME (Supply) and SU (Non-LTME) for the construction of Rooppur Nuclear Power Plant, was held from 21 - 23 Dec. 2020 at Rooppur Project Site Office, Rooppur, Ishwardi, Pabna

- A meeting convened by the Member Physical Science to finalize Communication Plan 2020 for increasing public awareness of the construction of Rooppur Nuclear Power Plant, was held from 23 - 24 Dec. 2020 at Rooppur Project Site Office, Rooppur, Ishwardi, Pabna
- A meeting convened by the Member Engineering for the evaluation of Construction and Erection Works until 24 Dec. 2019 of Rooppur Nuclear Power Plant Project in accordance with General Contract, was held on 26 Dec., 2019 in Rooppur NPP Bhavan, 4 Kazi Nazrul Islam Avenue, Shahbagh, Dhaka
- A meeting convened by the Member Engineering on the achievement of Commissioning Milestones (CM) under Construction of Rooppur Nuclear Power Plant Project, was held on 28 Dec. 2019 in Rooppur NPP Bhavan, 4 Kazi Nazrul Islam Avenue, Shahbagh, Dhaka
- A meeting convened by the Member Engineering on the achievement of LTME and LTME Supply under Construction of Rooppur Nuclear Power Plant Project, was held on 28 Dec. 2019 in Rooppur NPP Bhavan, 4 Kazi Nazrul Islam Avenue, Shahbagh, Dhaka
- A meeting convened by the Member Engineering on the negotiation of Nuclear Fuel Supply Contract between Bangladesh and Russian Federation for the Rooppur Nuclear Power Plant was held from 14 - 24 Jan. 2020 in Rooppur NPP Bhavan, 4 Kazi Nazrul Islam Avenue, Shahbagh, Dhaka
- A meeting convened by the Chairman BAEC to achieve Milestone and to review Training Document Package TR, Uo.0008 of Rooppur Nuclear Power Plant Project, was held on 15 Jan. 2020 in Rooppur NPP Bhavan, 4 Kazi Nazrul Islam Avenue, Shahbagh, Dhaka
- A meeting convened by the Member Engineering to achieve Milestone and to review Training Document Package TR, Uo.0008 of Rooppur Nuclear Power Plant Project was held on 15 Jan. 2020 in Rooppur NPP Bhavan, 4 Kazi Nazrul Islam Avenue, Shahbagh, Dhaka
- A meeting convened by the Director QMD to achieve Milestone of Long Term Manufacturing Equipment (LTME) and SU (Non-LTME) for the construction of Rooppur Nuclear Power Plant was held from 27 - 29 Jan. 2020 at Rooppur Project Site Office, Rooppur, Ishwardi, Pabna
- A meeting convened by the Member Engineering on the on-site and off-site radiation monitoring of Training Assignment and PSAR for the Rooppur Nuclear Power Plant, was held from 6 - 8 Feb. 2020 in Rooppur NPP Bhavan, 4 Kazi Nazrul Islam Avenue, Shahbagh, Dhaka.
- A bilateral meeting between BAEC and four members delegation of Dept. of Atomic Energy (DAE), India convened by the Member Engineering on the radiation monitoring and emergency management for the Rooppur Nuclear Power Plant, was held from 9 - 13 Feb. 2020 in Rooppur NPP Bhavan, 4 Kazi Nazrul Islam Avenue, Shahbagh, Dhaka
- A meeting convened by the Member Engineering in related to Energy Metering System for Tariff and Main Electrical Scheme based on single line Diagram with Unit Tarnasformer Rating and power factor of Rooppur Nuclear Power Plant Project was held on 4 Mar. 2020 in Rooppur NPP Bhavan, 4 Kazi Nazrul Islam Avenue, Shahbagh, Dhaka
- A meeting convened the by the Additional Secretary, Ministry of Science and Technology on Program Management Board (PMB) for the extension Inter-Agency Agreement (IAA) between global Centre for Nuclear Energy Partnership (GCNEP) Dept. of Atomic Energy Government of India and Bangladesh Atomic Energy Commission (BAEC) Ministry of Science & Technology Government of People's Republic of Bangladesh on Cooperation Regarding Nuclear Power Plant Project in Bangladesh, was held on 5 Mar. 2020 in Rooppur NPP Bhavan, 4 Kazi Nazrul Islam Avenue, Shahbagh, Dhaka
- A meeting convened by the Member Engineering for the evaluation of Construction and Erection Works of Rooppur Nuclear Power Plant Project in accordance with General Contract, was held on 5 Mar. 2020 in Rooppur NPP Bhavan, 4 Kazi Nazrul Islam Avenue, Shahbagh, Dhaka
- A meeting convened by the Director QMD for the completion and the preparation of report in related to the Incomming Inspection of Long Term Manufacturing Equpment (LTME) of Rooppur Nuclear Power Plant Project, was held on 8 - 10 Mar. 2020 in Rooppur NPP Bhavan, 4 Kazi Nazrul Islam Avenue, Shahbagh, Dhaka

- A meeting convened by the Hon'ble Cabinet Secretary of Prime Minister on project implementation progress held on 9 Mar. 2020 at Prime Minister's Office conference room.
- A meeting convened by the Member Engineering for the evaluation and completion of Long Term Manufacturing Equpment (LTME)- of M0, M1, M2, M3 Milestones of Rooppur Nuclear Power Plant Project in accordance with General Contract, was held on 15 Mar. 2020 in Rooppur NPP Bhavan, 4 Kazi Nazrul Islam Avenue, Shahbagh, Dhaka
- A meeting convened by the Hon'ble Minister of Ministry of Science and Technology on project implementation progress, was held on 14 May 2020 in Rooppur NPP Bhavan, 4 Kazi Nazrul Islam Avenue, Shahbagh, Dhaka
- The 14th meeting convened by the Principal Secretary to the Hon'ble Prime Minister and Chief Coordinator of SDG to the Prime Minister's Office on Fast Track Project Monitoring Task Force, was held on 25 Jun. 2020 by Video Conferencing
- A meeting convened the by the Senior Secretary, Ministry of Science and Technology on ADP (Annual Development Program), was held on 25 Jun. 2020 in Rooppur NPP Bhavan, 4 Kazi Nazrul Islam Avenue, Shahbagh, Dhaka

VI. NUCLEAR SAFETY, SECURITY AND SAFEGUARDS DIVISION (NSSSD), HQ

Objective/Introduction

- 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. Dept. of Energy (USDOE), Japan Atomic Energy Agency (JAEA), Forum for Nuclear Cooperation in Asia (FNCA) and emerging Asia-Pacific Safeguards Network (APSN) for the issues of nuclear safeguards, safety, security and physical protection of radioactive materials and associated facilities.

Activities

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

Name of the participant	Title of the event	Organizer	Date	Place
Dr. M. S. Rahman	Workshop and Research Program by the National Research Foundation of Korea & Kyungpook National University	NRF, South Korea	26 Nov.- 4 Dec. 2019	Seoul, South Korea
	Pre-shipment Visit of the Tele-Cobalt unit and Accessories	Best Theratronics, Canada	9-15 Dec. 2019	Toronto, Canada
Dr. A. Imtiaz	Consultancy Meeting on Implementation of Safety Culture Assessment Methodology in Nuclear Power Organizations	IAEA	14-18. Oct 2019	Vienna, Austria
	FNCA 2019 Workshop on Nuclear Security and Safeguards Project	PNRI & MEXT	26-28. Nov 2019	Manila, Philippines
H. M. B. Alam	International Train-the-Trainers Course on the Physical Protection of Nuclear Material and Nuclear Facilities	IAEA	09-13 Dec. 2019	New Delhi, India
	Technical Meeting/Workshop on Nuclear Security Detection Architectures	NSPC & BAEC	24-27 Feb. 2020	Dhaka

2. Collaboration Work(s)

- Working as a national focal point for Bangladesh's Integrated Nuclear Security Support Plan (INSSP). According the action plan of INSSP, an Expert Mission on Nuclear Security Detection Architecture (NSDA) was held in Dhaka on 24-27 February 2020
- 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.
- Participation in the 'Nuclear Security and Safeguards Project' under the cooperation activities of FNCA. Bangladesh participated in the 9th Workshop on this Project held in Manila, Philippines on 26-28 November, 2019
- 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. Dept. of Energy.

VII. PLANNING AND DEVELOPMENT DIVISION (PDD), HQ

As a premier research organization of the country, Bangladesh Atomic Energy Commission (BAEC) has been engaged in research and development activities in different disciplines of nuclear science & technology. BAEC contributes socio-economic development of Bangladesh through peaceful application of nuclear energy. In according National science and technology policy BAEC has been undertaking initiatives for upgrading and extension of different laboratories through development projects.

In this regard, 12 (Twelve) projects of Bangladesh Atomic Energy Commission (BAEC) were incorporated in the Annual Development Program (RADP) of 2019-2020.

Activities

The total RADP allocation of the year 2019-2020 for implementation of ongoing project of Bangladesh Atomic Energy Commission was Tk. 1511023.00 Lakh. Out of this granted allocation, Tk. 1150084.85 Lakh had been spent up to 30 Jun., 2020 making an implementation rate of 76.11%. 12 (Twelve) new projects, in total have been proposed for the FY 2019-2020 from BAEC to the concerned Ministry. The entire pictures on the advancement of all the development projects are shown in Table-1.

1. Advancement of The Development Project of BAEC under RADP

(Taka in lakh)

Sl. No	Name of the project, project implementation period	Estimated cost total (F.E)	Cumulative expenditure upto, Jun. 2019 (F.E)	Revised allocation for the year 2019-2020 (F.E)	Expenditure during 1st Jul., 2019 to 30th Jun. 2020	% of expenditure against allocation upto 30th Jun. 2020	Achievement of the projects
1	2	3	4	5	7	9	10
	On-Going Projects:						
1.	Modernization of Food and Radiation Biology Facilities of AERE, Savar, Apr. 2016 - Jun. 2020	4984/- 2350/-	4004.84 2350/-	727/- 0	727/- 0	100% 100%	Completed Jun. 2020
2.	Construction of Rooppur Nuclear Power Plant, Apr. 2016 - Dec. 2025	11309291.28 10120000/-	2360603.12 2333582.12	1484607/- 235480/-	1128763.38 235480/-	76.03% 99.95%	On goining
3.	Development of Human Resources & Establishment of Residential Accommodation Facilities for the Radiation Testing and Monitoring	1825/- 0.00	816/- 0.00	997.00 0.00	557.50 0.00	55.92% 92.22%	On goining

Sl. No	Name of the project, project implementation period	Estimated cost total (F.E)	Cumulative expenditure upto, Jun. 2019 (F.E)	Revised allocation for the year 2019-2020 (F.E)	Expenditure during 1st Jul., 2019 to 30th Jun. 2020	% of expenditure against allocation upto 30th Jun. 2020	Achievement of the projects
1	2	3	4	5	7	9	10
	Laboratory, Mongla, Apr. 2017 - Jun. 2021						
4.	Enhance Capacity of Institute of Nuclear Medicine and Allied Sciences (INMAS) at Dhaka, Chittagong, Khulna, Sylhet, Rajshahi, Dinajpur and Rangpur, Jul. 2017 - Jun. 2021	21303/- 12142/-	11600/- 11105/-	6350/- 3650/-	5365/- 3650/-	84.49% 100.00%	On goining
5.	Sitting for Nuclear Power Plant in the Southern Part of Bangladesh. Jul. 2017 - Jun. 2021	977.34 0.00	255.67 0.00	594/- 0.00	424.70 0.00	71.50% 97.13%	On goining
6.	Establishment of Institute of Nuclear Medicine and Allied Sciences (INMAS) at 8 Medical Collage Hospital Campuses in the country, Jul. 2017 - Jun. 2021	62228.80 19520/-	2412.95 0	8944/- 0	6900/- 0	77.15 100.00%	On goining
7.	Establishment of Calibration and Quality Control Facilities for Radiotherapy, Diagnostic Radiology and Neutron, Jul. 2018 - Jun. 2021	4679.15 2810.60	789/- 624/-	1373/- 800/-	753.50 260/-	54.88% 100%	On goining
8.	Technical Survery Project for High Power Nuclear Research Reactor in Bangladesh, Jul. 2018 - Jun. 2021	822.58 0	142/- 0	184/- 0	125.01 0	67.94 100%	On goining
9.	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. 2022	67300/- 3237/-	213/-/- 0	2500/- 365/-	2464.25 365/-/-	98.57% 100.00%	On goining
10.	Improvement and modernization of the laboratory Facilities of Institute of Electronics, Jul. 2018 - Dec. 2020	3431.50 2070/-	79.50 0	812/- 0	702.38 0	86.50% 99.07%	On goining
11.	Balancing, Modernization, Refurbishment and Extension (BMRE) of Safety Systems of the 3 MW TRIGA Mark-II Research Reactor Facility at AERE, Savar, Dhaka, Jul. 2018 - Jun. 2021	7494.84 2120/-	134/- 0	129/- 375.00	771.32 375/-	59.38 100.% 00%	On goining
12.	Screening of Congenital Hypothyroidism in Newborn Babies (Phase-2), Jul. 2018 - Aug. 2021	4770.16 1200/-	463/-/- 175/-	2636/- 726.44	2530.81 726.44	96.01% 100%	On goining
Total		11489108.85 10203329.60	2381513.13 2347836.12	1511023/- 241396.44	1150084.85 240481.44	76.11% 99.94%	-

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 2020-2021	Remarks
Proposed new-project					
1.	Establishment of Institute of Nuclear Medicine and Allied Sciences (INMAS) at 3 Medical Collage Hospital Campuses in the country, Jul. 2020 - Jun. 2024	Unapproved	27972/- 18586.77	0	Weighting for approved of planning commission
2.	Enhance Capacity buildup and Development of Research and Services at Atomic Energy Centre Dhaka (AECD), Jul. 2020 - Jun. 2023	Unapproved	18586.77	0	Weighting for approved of planning commission

Sl. No	Name of the project, approval status and implementation period	Approval status	Estimated cost Total	Proposed ADP for the year of 2020-2021	Remarks
3.	Capacity building and Strengthening of Atomic Energy Centre, Chattogram, Jul. 2020 - Jun. 2023	Unapproved	8784.12	0	Weighting for approved of planning commission
4.	Installation of high-capacity nuclear research reactors at the Atomic Energy Research Institute. Jul. 2020 - Jun. 2027	Unapproved	870425/-	0	Weighting for approved of planning commission
5.	Replacement of the Existing Gamma Source at Savar of Bangladesh Atomic Energy Commission, Jul. 2020 - Jun. 2023	Unapproved	4988/-	0	Weighting for approved of planning commission
6.	Strengthening of Bangladesh Atomic Energy Commission (BAEC) for Geological Survey, Jul. 2020 - Jun. 2023	Unapproved	18545/-	0	Weighting for approved of planning commission
7.	Establishment of Center for Cell Biology and Bioengineering, Jul. 2020 - Jun. 2024	Unapproved	56633.07	0	Weighting for approved of planning commission

VIII. QUALITY MANAGEMENT DIVISION (QMD), HQ

Introduction

Like past few years Quality Management Division (QMD) was actively involved in the activities of RNPP Construction Project through different committees. Besides, the Scientists of this Division were also engaged in some other tasks like preparing "Service Profile Booklet", updating "BAEC Service Regulations" in light of Bangladesh Atomic Energy Commission Act, 2017, drafting criteria on "Awarding Medals to Scientists of BAEC in 9 Categories in order to encourage them in Scientific Research on the Occaission of Celebrating Birth Centenary of Father of the Nation Bangabandhu Sheikh Mujibur Rahman", evaluating research work under Physical Sciences and Engineering Domain, providing important working documents for evaluating research work under Physical Sciences, Biological Sciences and Engineering Domain, updating draft of quality procedure, performing duties as other different Committee Members and some other (organogram, Innovation team, comments on policies related etc.) tasks.

Activities

1. Quality Inspections of RNPP Construction Project

- Performed duties as Incoming Control Inspection Team Members at Rooppur Nuclear Power Plant (RNPP) Construction Site for General Equipment and Long Term Manufacturing Equipment (LTME) under Quality Class QA-1, QA-2 & QA-3 at different times such as 21-24 Jul., 2019; 25-27 Aug., 2019; 11-12 Sept., 2019; 07-09 Oct., 2019; 10-12 Dec., 2019; 21-23 Dec., 2019; 27-29, Jan., 2020; 08-10 Mar., 2020
- Performed duties as Negotiation Committee Member to finalize Nuclear Fuel Supply Contract for Rooppur NPP in line with Inter Governmental Agreement (IGA) with Russian Federation
- Performed duties as Member of the Joint Training Advisory Commission (JTAC) for conducting Training Program of Rooppur NPP Operating Personnel under Appendix 14 of General Contract
- Performed duties as Technical Committee Member for the Evaluation of Construction and Erection Works of Rooppur NPP
- Performed duties as Committee Member to review the Health, Safety and Environment related activities linked with Rooppur NPP Implementation
- Performed duties as Member of the Entry Level Test conduct committee for the training of Rooppur NPP Operating Personnel in Russian Federation
- Actively involved in reviewing RNPP Construction Project related documents
- Participated in several Milestone Achievement associated meetings.

2. Project

Radiological Consequence Analysis due to Accidental Release of Radioxenon from TRIGA Research Reactor, Special Allocation Project of Ministry of Science & Technology, Government of Bangladesh, Project Code: 517 (25-Physics), 2018-19.

3. Updating

- Procedure for Management of Transport System of BAEC Head Office (BAEC/SOP-018)
- BAEC best practice list
- BAEC service regulations
- BAEC organogram
- Draft policies for institutions other than BAEC
- Criteria on Awarding Medals to Scientists of BAEC in 9 Categories in order to encourage them in Scientific Research on the Occaission of Celebrating Birth Centenary of Father of the Nation Bangabandhu Sheikh Mujibur Rahman

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

Name of the participant	Title of the event	Organizer	Date	Place
Dr. M. Q. Huda	Inspection of Verification Tests of Mathematical Models of Full Scope and Analytical Simulators	BAEC	15-26 Jul. 2019	Moscow, Russia
	Workshop on To support the development and upgrade the construction inspection and oversight Program	IAEA	18-22 Aug. 2019	Dhaka
	Joint Training Advisory Commission Meeting related with RNPP Operating Personnel Training Program	BAEC	05-12 Nov. 2019 and 22-31 Jan. 2020	Moscow, Russia

5. Other

- Working as the committee member of "Innovation Team"
- Performed duties as Member of the Editorial Board of the BAEC Journal of Nuclear Science & Applications
- Working as the committee member of Dept.al Promotion Committee-3 of BAEC
- Working as Topical Group Leader of Safety Assessment for Asian Nuclear Safety Network (ANSN).
- Working as the committee member to review and fill-up the IAEA prescribed Questionnaire relating to Safeguards
- Working as National Project Team (NPT) Member for IAEA Non-RCA Project RAS0080
- Working as the committee member of the Review Committee for the new Annual Development Project
- Working as the committee member of the Review Committee to evaluate Research Work carried out within Physical Sciences and Engineering Domain of BAEC.

IX. SCIENTIFIC INFORMATION DIVISION (SID), 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, periodicals 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 technological development of all branches of sciences with particular emphasis to the nuclear technology research and development
- Maintaining liaison with the news media, TV, Radio, etc. to disseminate news of scientific programs, 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, 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 BACE 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
- The key responsibilities are as follows:

Description of work	Quantity	Remarks
Publishing BAEC Annual Report 2018- 2019	300	Published, distributed and uploaded to the BAEC website *www.baec.gov.bd*
Arranging/Attending science fair/digital fair	4	Successfully completed
Publishing BAEC Diary 2020	1300	Published and distributed
Publishing telephone directory 2020 in Bangla	780	Published and distributed
Publishing Tender/Advertisement etc. to the newspaper	63	Published in the 110 daily newspapers
Newspaper clipping	231	Successfully completed
Press release on training, workshop conducted by BAEC and other BAEC programmes	11	Published in the daily newspapers
Photographic service (processed, printed and supplied)	20000	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	395	Nomination letters were distributed to the relevant participants
Provide National Parliamentary questions and answers	1	Successfully completed
Provide Parliamentary Committee Report	11	Successfully completed
Provide BAEC information for Preparation of Ministry Annual Report	2	Successfully completed
Preparation of annual performance agreement 2019-2020 between BAEC & MOST & Different Inst./Centre/ Unit with BAEC	32	Successfully completed

Description of work	Quantity	Remarks
Preparing APA reports of BAEC	18	Successfully completed
Providing input for different bilateral contract/MoU/ international conference/meeting	34	Successfully completed
Preparing and providing opinions on the issues, acts, laws, etc.	21	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	5	Successfully completed
APA Report uploaded to APAMS of Cabinet Division	5	Successfully completed
Printing BAEC Annual Calendar 2020	2500	Successfully completed

X. HUMAN RESOURCES DIVISION (HRD), HQ

Objective/Introduction

The Human Resource Management approach remains integrated to the organization's core strategy and vision. It seeks to optimize the use of human resources for the fulfillment of organizational goals. This strategic and philosophical context of Human Resources Development and Management makes it more purposeful, relevant, and more effective compared to the traditional Establishment approach. With this view, the Human Resources Division (HRD) is launched in BAEC. The HRD Division is working directly under the Chairman and bears the prime responsibility for the enhancement of skills and management of human resources of BAEC.

Activities/Program(s)

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

Name of the Participant	Title of the event	Organizer	Date	Place
Dr. S. M. Hossain	7th Meeting of the RCA Mid-term Strategy Coordination Working Group	IAEA	17 – 21 Feb. 2020	Vienna, Austria
	Regional Meeting on the Management of Training Systems for Nuclear and Radiological Safety	IAEA	04-08 Nov. 2019	Jakarta, Indonesia
	IAEA/RCA Working Group Meeting for Coordination of the RCA Medium Term Strategy	RCA & IAEA	29 July–01 Aug., 2019	Seoul, Korea

2. Academic

- Conducted a course entitled "NSE 331: Nuclear Chemical Engineering and Corrosion" for Level-3 Term-2 in the Department of Nuclear Science and Engineering, Military Institute of Science and Technology
- Working under the program of academic collaboration with different Departments of various Universities through the supervision of Ph.D., M.Phil and M.Sc. students.

3. Lecture Delivered

- Lectures were delivered to the BAEC BNOC Training Course 2018 (1st Batch): Nuclear Physics Part-I, Nuclear Physics Part-II and Nuclear Reactions and their applications
- Lectures were delivered to the NDT Radiographic Testing Level-2 Training Course: i) penetrating radiation & radioactivity; ii) interaction of radiation with matter; iii) radiographic equipment- gamma ray.

4. Collaboration Work(s)

4.1 Arranged to sign Memorandum of Understanding (MoU) between BAEC and Universities

- The Military Institute of Science and Technology (MIST), Dhaka, Dated: 02-12-2019
- University of Dhaka, Dated: 10-02-2020

4.2 Collaboration with the international bodies for the development of nuclear workforce

- Worked as a member of IAEA RCA Mid Term Strategy Coordination Group
- Worked as the Leader of IAEA ANSN Education and Training Topical Group
- Worked as a IAEA Technical Group of Human Resource Management for Nuclear Energy;
- Worked as the Counter part of the RCA Project entitled "RAS/0/073: Supporting Human Resource Development and Nuclear Technology"
- Gave support to the ADP projects of BAEC for manpower recruitment, project implementation, etc.
- Work with JAEA Steering Committee as a BAEC representative
- Worked as a member of TC Projects evaluation.

5. Mitigated Work(s)

- At different time providing fifty two (52) nos. of circular for nomination of training of BAEC personals in several disciplanes
- At different time providing three (3) nos. of circular for nomination of on-line training of BAEC personels in three different disciplanes
- Arranged two Memorandum of Understanding (MoU) signing ceremony between BAEC and Other Institutes
- মাধ্যমিক ও উচ্চ মাধ্যমিক পর্যায়ের বর্তমান শিক্ষা কারিকুলামে পরমাণু বিজ্ঞান ও প্রযুক্তি বিষয়ে বিদ্যমান বিষয়বস্তুসমূহ যথাযথভাবে সহজবোধ্য আকারে হালনাগাদকরণ।

6. Others

- Give logistic supports to the BAEC related to human resources development, management and other relevant activities under both revenue and projects.
- Nomination procedure of Bangladesh Atomic Energy Commission (BAEC) employees to attend various training program conduct by different organizations e.g. BIM, NAPD, RPATC, EIB etc. are being handled by the Human Resources Division of BAEC
- Worked as a Member of the Syllabus Formation Committee in M.Sc., Dept. of Nuclear Engineering, University of Dhaka
- Worked as a member of Editorial Board of the journal of NucSenate Member of Jahangir Nagar University in Research Category.

XI. 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 and guests of AERE.

Activities

- Publication of AERE Technical Report, vol. 24

- Acquisition of 26 Books and Journals: Co-operation in Seminars/Symposia/Workshops held in AERE
- Attendance to 17 Delegates/543Visitors: E-journal Service
- Database Service
- Fax service.
- Current Awareness Service (CAS) and Selective Dissemination Service (SDS)
- News Clipping Compilation and Preservation
- Routine work(s) such as, photography, documentation and reprography service etc.

XII. 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 is a four storied building complex having total floor area of 36,395 sq. ft. The ground floor is used for the sitting accommodation of the Director, Course Coordinator, Experts, Scientists and Administrative staffs. The other floors and rooms are used for the accommodation of trainees and trainers during training period. 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. Considering all these necessities TI is conducting different kinds of training programs round the year as per the approval of BAEC.

Activities

1. Manpower Development and Training Program

Title of the Event	Date	Place	No. of participants
In-house training course on General Behavior	25-27 Aug. 2019	TI	37
Training Course on Radiation Protection for Radiation Workers and RCO's of BAEC & others Medical Facilities	15-19 Sept. 2019	TI	27
Training Course on Public Procurement Regulation-2008 (PPR-2008)	22-31 Oct. 2019	TI	26
FTC on Nuclear and Radiological Emergency Preparedness Course	24 Nov.- 05 Dec. 2019	TI	28
FTC on Environ. Radioactivity Monitoring Course	12-16 Jan. 2020	TI	26
FTC on Reactor Engineering Course	09- 27 Feb. 2020	TI	17
Basic Nuclear Orientation Course (BNOC)* (incompleted because of COVID-19 pandemic problem)	15 Mar.- 14 May 2020	TI	41
Total			202

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

Name of the participant	Title of the event	Organizer	Date	Place
A. K. Das	Technical Meeting on Educational Networks	IAEA	1-05 Jul. 2019	Vienna, Austria.
M. I. Chowdhury	Training Course on Nuclear Energy Officials (TC-NEO)	MEXT/ JAEA	2-20 Dec. 2019	WERC, Fukui, Japan

3. Stakeholder Meeting

Title of the event	Date	Place	No. of participants
Mainstreaming Disaster Risk Reduction	9-13 Nov. 2019	TI	20

4. Lecturer Delivered

Dr. Ananda Kumar Das delivered a series of Lectures on i) Basics of Crystallography, ii) Materials Properties of a Nuclear Power Reactor, iii) Degradation or Damage of Materials due to Radiation Exposure iv) Basics of Radiation Physics, v) Disaster Management (Bangladesh Perspective) and vi) Official Courtesy etc. in the Basic Nuclear Orientation Course (BNOC), Follow-up Training Courses and other courses arranged in TI within 2019-20 fiscal years.

5. Training Courses Arranged Outside of TI for BAEC Employees

Title of the event	Date	Place	No. of participants
Office Management & ICT training course	12-23 Jan. 08-19 Mar. 2020	RPATC*	2
Fundamental Financial Management Course	09-20 Feb. 2020	RPATC*	1

*****Rural Public Administration Training Center, Eskaton, Dhaka

6. Service Rendered and Revenue Income

Type of service	Income
Dormitory rent	192000/-
Course fee	55000/-
Total	247000/-

XIII. FINANCE AND ACCOUNTS DIVISION (FAD), HQ

Activities

1. Revenue Budget Allocation and Fund Release

(in lac)

Code no.	Head of accounts	Source of fund (2019-2020)			
		Allocation from Govt.	Received from BAEC own income	Received from bank interest	Total received
3631101	Salary support	7710/-	------	------	7710/-
3631102	Allowance support	6625/-	------	------	6625/-
3631103	Goods and service support (with service charge)	2594/-	4040/-	------	6634/-
3631104	Pension and retirment support	4306/-	------	------	4306/-
3631108	Research grant	304/-	126/-	------	430/-
3631199	Others grant	401/-	------	------	401/-
	Sub-total	21940/-	4166/-	------	26106/-
3632102	Machinaries grant	655/-	----	476.30	1131/-
3632103	Vicle grant	100/-	71/-	------	171/-
3632105	Ict grant	50/-	18/-	------	68/-
3632106	Others capital grant	30/-	545/-	138/-	713/-
	Sub-total	835/-	634/-	614.30	2083/-

Total	22775/-	4800/-	614.30	28189.30

2. Center/Institute Wise Revenue Budget Allocation

(in lac)

Name of the Centre/Institute	Revenue budget allocation
BAEC, Head Quarter	3156/-
Works Branch, BAEC, Dhaka	1581/-
BAERA, Dhaka	400/-
Atomic Energy Centre, Dhaka	2808/-
AERE, Savar	6634/-
National Institute of Nuclear Medicine & Allied Sciences, Dhaka	1247/-
Institute of Nuclear Medicine & Allied Sciences, Chattogram	278/-
Institute of Nuclear Medicine & Allied Sciences, Rajshahi	280/-
Institute of Nuclear Medicine & Allied Sciences, Dinajpur	231.50
Institute of Nuclear Medicine & Allied Sciences, Sylhet	188.50
Institute of Nuclear Medicine & Allied Sciences, Dhaka	554/-
Institute of Nuclear Medicine & Allied Sciences, Barishal	254/-
Institute of Nuclear Medicine & Allied Sciences, Khulna	271/-
Institute of Nuclear Medicine & Allied Sciences, Rangpur	290/-
Institute of Nuclear Medicine & Allied Sciences, Mymensing	382/-
Institute of Nuclear Medicine & Allied Sciences, Bogura	288/-
Institute of Nuclear Medicine & Allied Sciences, Cumilla	167/-
Institute of Nuclear Medicine & Allied Sciences, Faridpur	208/-
Institute of Nuclear Medicine & Allied Sciences, Midford	302/-
Institute of Nuclear Medicine & Allied Sciences, Cox’s Bazar	142/-
Atomic Energy Centre, Chattogram	215/-
BSMEC, Cox’s Bazar	191/-
RNPP, Pabna	191.50
RTML, Mongla	112.50
Foreign Exchange Branch, BAEC, Dhaka	1591/-
Pension & retirment benefit Branch, BAEC, Dhaka	4306/-
Service Charge Branch, BAEC, Dhaka	1920/-
Total	28189/-

XIV. SUPERVISION OF THESIS

ATOMIC ENERGY CENTRE (AEC), DHAKA

Chemistry Division, AECD

1. Joint Supervisor: Dr. Shamshad Begum Quraishi, "Investigation of Heavy Metal Concentration of Sea Water in the North Eastern Part of the Bay of Bengal", M. Sc. thesis (Devashis Das), Department of Oceanography, Faculty of Earth and Environmental Science, University of Dhaka, 2019.
2. Joint Supervisor: Dr. Shamshad Begum Quraishi, "Community Structure of Meiobenthos in the Inter-tidal Area of Sandwip and Kuakata Sea Beach", M. Sc. thesis (Nusrat Jahan Tania), Department of Oceanography, Faculty of Earth and Environmental Science, University of Dhaka, 2019.
3. Joint Supervisor: Dr. Shamshad Begum Quraishi, "Association of α-amylase Activity with Glycated Hemoglobin and Trace Elements in Impaired Glucose Metabolism", M. Pharm. thesis (Dewan Ashik Mahmud), Department of Pharmacy, Noakhali Science and Technology University, 2019.
4. Co-Supervisor: Dr. Shamshad Begum Quraishi, "Preparation of Carboxylic Acid Abundant Graphite Oxide (GO) and Its Application in Lead (Pb) Removal from Synthetic Waste Water", M.Sc. thesis (Md. Saddam Hossain), Department of Chemistry, Jahangirnagar University, 2019.
5. Co-Supervisor: Dr. Shamshad Begum Quraishi, "Preparation of Mg-Al Layered Double Hydroxide Shielded with Graphene Oxide and Its Application in Dye Removal from Synthetic Waste Water", M.Sc. thesis (Loknath Dhar), Department of Chemistry, Jahangirnagar University, 2019.
6. Joint Supervisor: Dr. Shamshad Begum Quraishi, "Assessment of Heavy Metals and Their Sources in Fishes of Closed Cultured Pond", M.Sc. thesis (Sheikh Saiful Islam), Department of Zoology, Jagannath University, 2019.
7. Joint Supervisor: Dr. Shamshad Begum Quraishi, "Heavy Metal Contamination in Commercial Fish Feed and Fish", M. Sc. thesis (Farjana Rahman), Department of Zoology, Jagannath University, 2019.
8. Co-Supervisor: Dr. Shamshad Begum Quraishi, "Estimation of Pb and Cr Content in Beef Collected from Dhaka City", M. Sc. Thesis (Rubel Akand), Institute of Food and Nutrition Science, University of Dhaka, 2020.
9. Joint Supervisor: Dr. Shamshad Begum Quraishi, "Assessment of Groundwater Chemical Composition and Their Characteristics: A Case Study of Chandpur District", M. Sc. Thesis (Fahim Siddique), Department of Environmental Science, Noakhali Science and Technology University, 2019.
10. Joint Supervision: Dr. Yeasmin Nahar Jolly "Assessment of Heavy Metal and Microbial Contamination in Water of Roadside Restaruants in Noakhali", M.S. Thesis (Farzana Akter), Department of Biotechnology and Genetic Engineering, Noakhali Science and Technology University, Jan.,2020.
11. Joint Supervision: Dr. Yeasmin Nahar Jolly, "Assessment of Environmental and Human Health Risks of Heavy Metals Road Dust in Dhaka City", M.S. Thesis (Sumaya Nasrin), Department of Environmental Science and Resource Management, Mawlana Bhashani Science and Technology University, Dec., 2019.
12. Joint Supervision: Dr. Yeasmin Nahar Jolly, "Assessment of Nutritional Status and Possible Health Risk Due to Dietary Intake of Heavy Metal of Different Food Stuffs", M.S. Thesis (Shammi Akter), Department of Food and Nutritional Science, Nov., 2019.
13. Joint-supervisor: Dr. M. Safiur Rahman, "Contamination and Ecological Risk Assessment of Heavy Metal in Soils Around the Export Processing Zone", Ishwardi, Pabna, Bangladesh, M.S. Thesis (Hamidur Rahman), Department of Applied Chemistry and Chemical Technology, Islamic University (IU), Nov., 2019.
14. Joint-supervisor: Dr. M. Safiur Rahman, "Chemical Characterization of Water Quality for Drinking and Agricultural Purposes: A Case Study Ishwardi, Pabna, Bangladesh", M.S. Thesis (Shawon Parvez), Department of Applied Chemistry and Chemical Technology, Islamic University (IU), Nov., 2019.

15. Joint-supervisor: Dr. M. Safiur Rahman, "Present Status of Heavy Metals Contamination in the Soil of Tannery Village, Bangladesh", M.S. Thesis (Sadia Jahan), Leather Institute, Dhaka University (DU), Nov., 2019.
16. Joint-supervisor: Dr. T. R. Choudhury, "Evaluation of Some Metals Accumulated in Animal Diversity of Cox's Bazar and Teknaf Areas in Bangladesh and Histo-pathological Evidences in the Brain", M.S. Thesis (Kazi Fahima Siddika), Department of Zoology, University of Dhaka, Aug., 2019.
17. Joint-supervisor: Dr. T. R. Choudhury, "Accumulation of Heavy Metals in the Animal Biodiversity of River Bank Areas of Buriganga and Turag in Dhaka and Histo-pathological Evidences in the Brain", M.S. Thesis (Israt Jahan), Department of Zoology, University of Dhaka, Aug., 2019.
18. Joint-supervisor: Dr. T. R. Choudhury, "Evaluation of Heavy Metals Accumulated in Some Animals of Gaibandha District in Bangladesh and Histo-pathological Evidences in the Brain", M.S. Thesis (Md. Mosharraf Hossain), Department of Zoology, University of Dhaka, Aug., 2019.
19. Joint Supervision: Dr. Yeasmin Nahar Jolly "Assessment of Environmental and Human Health Risks of Heavy Metals Road Dust in Dhaka City", M.S. Thesis (Md. Eusuf Sarker), Department of Environmental Science and Resource Management, Mawlana Bhashani Science and Technology University, Dec., 2019.
20. Joint-supervisor: Dr. T. R. Choudhury, "Hydro-chemical Investigation of Groundwater Quality and Human Health Risks: A Case Study of Jessore Sadar Upazila, Jessore, Bangladesh", B.Sc Thesis (Md. Nobin Hossain,), Department of Environmental Science and Disaster Management, Noakhali Science and Technology University, Bangladesh, Nov., 2019.
21. Joint-supervisor: Dr. T. R. Choudhury, "Assessment of Impurities Associated Human Health Risks of Locally Available Black Salts from Dhaka City, Bangladesh", B.Sc Thesis (Md Kamrul Islam), Department of Environmental Science and Disaster Management, Noakhali Science and Technology University, Bangladesh, Nov. 2019.
22. Joint-supervisor: Dr. T. R. Choudhury, "Removal of Cr (III) Using Activated Carbon Produced from Vegetable Tanned Leather Shaving Dust", M.S. Thesis (Sarifa Akhter), Institute of Leather Engineering and Technology, University of Dhaka, Bangladesh, Nov., 2019.
23. Joint-supervisor: Dr. T. R. Choudhury, "Study on Heavy Metals in Water, Sediment, Plant and Food Stuff Around the Island Bhola of Bangladesh", M. Phil Thesis (Tanjeela Islam), Department of Applied Chemistry and Chemical Engineering, University of Dhaka, Dec., 2019.
24. Joint-Supervisor: A. R. M. Tareq, "Vertical and Horizontal Distribution of Polycyclic Aromatic Hydrocarbons in an Urban River Sediments Affected by Tannery Effluents", M. Sc. Thesis (Sharman Sultana), Department of Environmental Science and Resource Management, University of Mawlana Bhashani Science and Technology, Mar., 2020.
25. Joint Supervisor: A. K. M. Atique Ullah, "Natural Antioxidant-based Synthesis of Silver Nanoparticles Using Some Medicinal Leaves and Their Applications against Cancerous Cell and Multidrug-resistant Strains", M. Sc. Thesis (M. Zakaria Rahman), Department of Physics, University of Dhaka, 2019.

Experimental Physics Division, AECD

26. Joint-Supervisor: Dr. K. M. A. Hussain, "Synthesis, Characterization and Optimization of ZnS Thin Film Using Chemical Bath Deposition (CBD) Method", M.Sc Thesis (Zubair Ahmed), Department of Electrical and Electronic Engineering, Islamic University of Kushtia-7003, February, 2020.

Health Physics Division, AECD

27. Joint-supervisor: Selina Yeasmin, "Assessment of Radioactivity and Radiological Hazard in Soil Sample collected from Guliakhali Sea Beach in Sitakunda, Bangladesh", B.S. Thesis (Debasish Sarker), Department of Nuclear Engineering, University of Dhaka, Jul., 2019.
28. Joint-supervisor: Selina Yeasmin, "Measurement of Radioactivity and Assessment of Radiological Hazard in Sand Sample Collected from Kuakata and Cox's Bazar Sea Beach in Bangladesh", B.S. Thesis (Madhurja Sarker), Department of Nuclear Engineering, University of Dhaka, Jul., 2019.

29. Joint-supervisor: Dr. Mohammad Sohelur Rahman, "Real-Time Radiation Monitoring in INMAS Mitford Hospital Campus by In-Situ method", 4th year B.Sc. Project (Md. Ahshan Habib), Department of Physics, PUST, Jul., 2019.
30. Joint-supervisor: Dr. Mohammad Sohelur Rahman, "Assessment of Environmental Radiation Hazard around BSMMU Campus by In-Situ method", 4th Year B.Sc. Project (Faria Hassan), Department of Environmental Sciences, JU, Oct., 2019.
31. Joint-supervisor: Dr. Mohammad Sohelur Rahman, "Real-time Environmental Gamma Radiation Monitoring in New Market Thana by In-Situ Method", M.S. Thesis (Isratuzzhan Khanom Sumi), Department of Physics, MBSTU, Jan., 2020.
32. Joint-supervisor: Dr. Mohammad Sohelur Rahman, "Continuous Indoor Radiation Monitoring at Atomic Energy Centre Dhaka Campus by Thermoluminescent Dosimeter", M. Sc. Thesis (Md. Rafiqul Islam), Department of Physics, MBSTU, Jan., 2020.

Materials Science Division, AECD

33. Co-supervisor: Dr. Mohammed Nazrul Islam Khan , "Synthesis and Chracterization of Y and Sn ions substituted Mg-Zn ferrites", Ph. D. Thesis (Md. Ashraf Ali), Department of Physics Chittagong University of Engineering and Technology, 2019.
34. Co-supervisor: Dr. Engr. Sheikh Manjura Hoque, "Study .of Structural and Magnetic Properties of Superparamagnetic and Ferromagnetic Iron Based Nanoparticles for Cancer Treatments", Ph. D Thesis (Shamima Nasrin), Department of Physics, Chittagong University of Engineering and Technology, 2019.
35. Co-supervisor: Dr. Engr. Sheikh Manjura Hoque, "Cultivation and Identification of Rat`s Bone Marrow Cell inside the 3D Porous Network of Synthesized Hydroxyapatite-Chitosan-Gelatin Based Scaffold", M.Sc. Thesis (Kazi Mohuna), Department of Physics, University of Dhaka, Feb., 2020.
36. Co-Supervisor: Dr. Md Al-Mamun, "Synthesis of Cobalt Ferrite-reduced Graphene Oxide Nanocomposite as Magnetic Adsorbent for Textile Dye Removal " M.Sc. Thesis (Gobinda Chandra Malick), Department of Physics, Science Engineering and Technology School, Khulna University, Dec., 2019.

Plasma Physics Division, AECD

37. Joint-supervisor: Dr. Md. Khairul Islam, "Study on the Soft x-ray Yield in a Dense Plasma Focus Device as a Function of Gas Pressure for Different Gases Using Lee model code", M. Sc. Thesis (Lima Akter), Department of Nuclear Engineering, University of Dhaka, Dhaka, Bangladesh, Jun., 2020.

Medical Physics Division, AECD

38. Co-Supervisor: Dr Rajada Khatun, "Dosimetric Characteristics of 6 MV Linear Accelerator", MSc Thesis (Shudeb Kumar Roy), Department of Physics, Pabna University of Science and Technology (PUST), Sept., 2019.

ATOMIC ENERGY CENTRE (AEC), CHATTOGRAM

39. Co-supervisor: Dr. Shahadat Hossain, "Assessment of Selected Heavy Metal Hazard in Road Deposited Sediment in Chittagong City Corporation", MS Thesis (Kazi Kader Newaz), Department of Disaster and Environmental Engineering, Chittagong University of Engineering & Technology, Nov., 2019.
40. Co-supervisor: Dr. Shahadat Hossain, "Concentration of Naturally Occurring Radioactive Elements ^{226}Ra, ^{232}Th and ^{40}K in the Sediment Samples of Muhuri River in Bangladesh", MS Thesis (Shaon Bhowmik). Department of Physics, University of Chittagong, Feb., 2020.
41. Co-supervisor: Dr. Shahadat Hossain, "Activity Concentrations of Naturally Occuring Radionuclides ^{226}Ra, ^{232}Th and ^{40}K in the Sediment Samples of Feni River, Bangladesh", MS Thesis (Shamima Zaman), Department of Physics, University of Chittagong, February, 2020.
42. Co-supervisor: Nipa Deb, entitled on "Investigation of Heavy metals in waste liquids discharged by the concerned Factories at Kalurghat Industrial Area, Chittagong, Bangladesh'', Project Paper (Md. Shahed Mia and Md. Jahid Hasan), Department of Civil Engineering, Southern University, Jul., 2019.

43. Co-supervisor: Dr. A. K. M. Saiful Islam Bhuian, "Study of Naturally Occurred Radioactivity and Heavy Metals Concentration in Wild Mushrooms in Chittagong Hill Tracts Area of Bangladesh", M.Phil Thesis (Troyee Barua), Department of Physics, Chittagong University of Engineering & Technology, 2019.

CENTRE FOR RESEARCH REACTOR (CRR), AERE

44. Supervisor/Co-supervisor: Engr. Ashraful Haque, "Study on Emergency Core Cooling System and Safety Features of TRIGA Mark-II Reactor", B.Sc. Thesis (Mayesha Tahsin, Azmery Islam Bandhon, Maj. Sadia Mahjabin), Department of Nuclear Science and Engineering, Military Institute of Science and Technology, 2019.
45. Supervisor/Co-supervisor: Engr. Mohammad Mezbah Uddin, "Study and Analysis of Safety Parameters of TRIGA Mark-II Research Reactor", B.Sc. Thesis (Alifia Aftab Psyche, Sharatul Zannat Ame and Marjia Afrin), Department of Nuclear Science and Engineering, Military Institute of Science and Technology, 2019.

INSTITUTE OF RADIATION AND POLYMER TECHNOLOGY (IRPT), AERE

46. Supervisor/Co-supervisor: Dr. Ruhul Amin Khan, "Design and Development of Solar Cell", MS Thesis (Prosenjit Barua, Roll-130), Institute of Energy, Dhaka University, Mar., 2020.
47. Supervisor/Co-supervisor: Dr. Ruhul Amin Khan and Md. Razzak, "Fabrication & Characterization on Fiber Reinforced Composite Materials: Effect of dye & Gamma Radiation", MS Thesis (Md. Nabi Newaz Niloy), Department of Applied Chemistry and Chemical Engineering, Faculty of Engineering & Chemical Technology, Dhaka University, Feb., 2020.
48. Supervisor/Co-supervisor: Dr. Ruhul Amin Khan and Md. Borhan Uddin, "Preparation and Characterization of Radiation Shielded Composite Materials", Mr Abu Hena Md Shamim Hasan, (ID No. 132340), Department of Mechanical Engineering, Dhaka University of Engineering & Technology (DUET), Gazipur, Mar., 2020.
49. Supervisor/Co-supervisor: Dr. Ruhul Amin Khan, "Development of High-Performance composite materials using glass fiber and metal alloy (TiO2)", MS Thesis (Md Osim Babu, Roll-14065057), Department of Applied Chemistry & Chemical Engineering, Rajshahi University, Jan., 2020.

INSTITUTE OF NUCLEAR SCIENCE AND TECHNOLOGY (INST), AERE

Nuclear Radiation and Chemistry Division, INST

50. Supervisors: Dr. Salma Sultana and Md. Saifur Rahaman, "Preparation of Polyvinyl alcohol (PVA), Pera-Styrene Sulphonic acid and Acrylic Acid Based Hydrogel by Using Gamma Radiation and Its Application in Dye Removal", M.S. Thesis (Arif Rahman Azady), Dept. of Department of Applied Chemistry and Chemical Engineering, Noakhali Science And Technology University (NSTU), Noakhali, Dec., 2019.
51. Supervisors: Dr. Salma Sultana and Md. Saifur Rahaman, "Preparation and Characterization of Hydrogel Based on Polyethylene Oxide (PEO), Dimethylacrylamide (DMAAm), Acrylic Acid (AAc) by Applying Gamma (ɣ) Radiation and Its Application for Dye Removall", M.S. Thesis (Champa Rani Sarkar), Dept. of Department of Applied Chemistry and Chemical Engineering, Noakhali Science And Technology University (NSTU),Noakhali, Dec., 2019.
52. Supervisors: Dr. Salma Sultana and Md. Saifur Rahaman, "Preparation of Starch, 2-Hydroxyethyl Acrylate, Styrene Sulfonic Acid Hydrogels by Gamma Radiation and Its Application in Dye Adsorption", M.S. Thesis (Khayrunnahar Nipa), Department of Applied Chemistry and Chemical Engineering, Noakhali Science And Technology University (NSTU), Noakhali, Jan., 2020.
53. Supervisors: Dr. Salma Sultana and Md. Saifur Rahaman, "Preparation of Starch/Acrylic Acid,4-Styrene Sulfonic Acid Hydrogel by Gamma Radiation and Its Application in Dye Removal", M.S. Thesis (Zahid Hasan), Department of Applied Chemistry and Chemical Engineering, Noakhali Science and Technology University (NSTU), Noakhali, Jan., 2020.

54. Supervisors: Dr. Nazia Rahman And Shahnaz Sultana, "Radiation Grafting of Acrylic Acid and Sodium Styrene Sulfonate on Non-woven Fabric and Its Application in Removal of Heavy Metals from Wastewater", M.S. Thesis (Md. Imran Biswas), Department of Chemistry, Jahangirnagar University, Jul., 2019.

55. Supervisor: Dr. Nazia Rahman, "Removal of Heavy Metals Using Radiation Grafted Polymer Adsorbent", B.Sc. Project Report (Md. Sajid Hasan and G. M. Foysal Ahmed), Department of Chemical Engineering, Jashore University of Science and Technology, Jul., 2019.

56. Supervisor: Dr. Nazia Rahman, "Uranium Recovery from Aqueous Solution Using Starch-acrylamide Hydrogel Prepared by Radiation Technique", B.Sc. Project Report (Mowsumi Akter And Md. Bashirul Islam), Department of Chemistry, Mawlana Bhashani Science and Technology University, Oct., 2019.

57. Supervisor: Dr. Nazia Rahman, "Poly (acrylic acid–co-acrylamide)-starch Hydrogel Using Radiation Technique for the Removal of Cr(III) from Tannery Effluent", M.S. Thesis (Md. Asifur Rahman), Institute of Leather Engineering and Technology, University of Dhaka, Oct., 2019.

58. Supervisor: Farah Tasneem Ahmed, "Internship Report on Quality Assessment of Ground Water of Atomic Energy Research Establishment (AERE), Savar, Dhaka and Its Corrosivity Evaluation", B.Sc. (Honour's) Internship Report (Kona Saha and Masud Rana), Department of Chemistry, Mawlana Bhasani Science and Technology University, Sept., 2019.

59. Supervisor: Farah Tasneem Ahmed, "Simultaneous Appraisals of Pathways and Probable Human Health Risks Associated with Trace Metals (TMs) and Fluorescence Dissolved Organic Matter (FDOM) Contamination in Groundwater from Lakshmipur Coastal Area, Bangladesh", B.Sc. Project Report, (Samia Akter), Department of Environmental Science and Disaster Management, Noakhali Science and Technology University, Nov., 2019.

60. Supervisor: Farah Tasneem Ahmed, "Industrial Training of Reactor Water Properties", B.Sc. Internship Report (Al Amin and Anik Sarker), Department of Nuclear Engineering, Dhaka University, Jan., 2020.

61. Joint Supervisor: Farah Tasneem Ahmed, "Use of Kitchen Waste Compost to Reduce the Transfer of Cadmium (Cd) from Soil to Plants", M. Sc. Thesis (Reyad Hossain Arif), Department of Chemistry, Mawlana Bhasani Science and Technology University, Jun., 2020.

Health Physics and Radioactive Waste Management Unit, INST

62. Supervisors: Dr. Md. Moazzem Hossain Miah, Dr. M. Moinul Islam and Dr. Khandoker Asaduzzaman, "Evaluation of Natural Radioactivity in Vegetables and Estimation of Radiological Dose to the Bangladeshi Population", M.Sc. Thesis **(**Md. Abdul Awal), Department of Physics, University of Chittagong, Chittagong, Bangladesh. Feb., 2020.

63. Supervisors: Dr. Khandoker Asaduzzaman, *Dr. Kamruzzaman Munshi and Dr. Mahfuza Begum, "Evaluation of Radioactivity, Impact of Gamma Radiation and Food Additives on Preservation and Nutritional Qualities of Cultured Fishes Collected from Fish Market of Dhaka city", M.Sc. Thesis (Fahmida Jannati Priya), Department of Zoology, Jahangirnagar University, Savar, Dhaka, Bangladesh. Jan., 2020, (*CSO, IFRB, AERE).

64. Supervisors: Dr. Khandoker Asaduzzaman, *Dr. Kamruzzaman Munshi and Dr. Mahfuza Begum. "Radiological Impact Assessment, Effect of Gamma Irradiation and Potassium Sorbate on Sensory, Chemical and Microbiological Changes of Non-cultured Fishes Available in Fish Market of Dhaka City", M.Sc. Thesis (Doni Akter), Department of Zoology, Jahangirnagar University, Savar, Dhaka, Bangladesh. Jan., 2020 (*CSO, IFRB, AERE).

65. Supervisors: Professor Dr. F. Nazrul Islam, Dr. Md. Shakilur Rahman and Tanjim Siddiqua. "Monte Carlo Simulation and Experimental Determination of R_{50} for High Energy Electron Beam Dosimetry in Radiotherapy", M.Sc. Thesis (Md. Yousuf Ali), Department of Physics, University of Rajshahi, Rajshahi-6205, Bangladesh, Dec., 2019.

66. Supervisors: Professor Dr. Md. Moazzem Hossain Miah, Dr. Debasish Paul, Dr. Md. Idris Ali and Md. Abu Haydar. "Estimation of Average Annual Committed Effective Dose Due to Intake of Medicinal Plants Collected from Chattogram District, Bangladesh", M.Sc. Thesis (M. J. Hossen), Department of Physics, University of Chittagong, Chittagong, Bangladesh, Feb., 2020.

Reactor and Neutron Physics Division, INST

67. Supervisor: Dr. Mohammad Amirul Islam, "Study on Experimental Cross Sections for $^{174}Yb(n,\gamma)^{175}Yb$ and $^{55}Mn(n,\gamma)^{56}Mn$ Reactions at New Energies of 0.0334 and 0.0536 eV Using Neutrons from TRIGA Nuclear Reactor", M.Sc. Engg. Thesis, (Md. Mustafa Zaved), Department of Nuclear Science and Engineering, Military Institute of Science and Technology, Mirpur, Jan., 2020.
68. Co-supervisor: Dr. Mohammad Amirul Islam, "Quality and Elemental Characterization of Common Spices of Bangladesh Using Nuclear Reactor-based NAA and Gamma Irradiation Techniques", M.Sc. Engg. Thesis, (Md. Mahfuzur Rahman), Department of Nuclear Science and Engineering, Military Institute of Science and Technology, Mirpur, Jan., 2020.
69. Co-supervisor: Dr. Mohammad Amirul Islam, "Assessment of Trace Elemental Contamination in Sediments of the Karnaphuli River, Chittagong Using Neutron Activation Analysis", M. Phil. Thesis, (Rani Das), Department of Physics, Chittagong University of Engineering and Technology, Chittagong, Sept., 2019.
70. Co-supervisor: Dr. Mohammad Amirul Islam, "Contamination and Ecological Risk Assessment of Heavy Metals in Sediments of the Sundarbans Ecosystem, Bangladesh", M. Sc. Thesis (Tridip Biswas), Environmental Sciences Discipline, Khulna University, Khulna, Aug., 2019.
71. Co-supervisor: Dr. Rahat Khan, "Potential Impact of Bituminous Coal-based Subcritical Thermal Power Plant on the Water Resources of Barapukuria Area, Dinajpur, Bangladesh", Ph.D. Thesis (Md. Ahosan Habib), Sustainable Energy Management, Faculty of Environmental Management, Prince of Songkla University, Songkhla 90112, Thailand, Jul., 2019.
72. Co-supervisor: Dr. Rahat Khan, "Monitoring of Environmental Radioactivity as a Signature of Anthropogenic Pollution", M.S. Thesis (Yeamin Faria Chowdhury), Department of Environmental Sciences, Jahangirnagar University, Jul., 2019.
73. Co-supervisor: Dr. Rahat Khan, "Elemental Analysis of Dhaleshwari River Sediments along the Tannery Industries, Savar, Dhaka", M.S Thesis (Md. Nakir Ahmed), Department of Environmental Sciences, Jahangirnagar University, Jul., 2019.
74. Co-supervisor: Dr. Rahat Khan, "Natural Radioactivity Measurements and Evaluation of Radiological Hazards in Sediment of Tista river, Bangladesh", B.Sc. Thesis (H. M. Touhidul Islam), Department of Disaster Management, Begum Rokeya University, Sept., 2019.
75. Co-supervisor: Dr. Rahat Khan, "Natural Radioactivity Concentration and Assessment of Radiological Hazards in Sediment of Brahmaputra River, Bangladesh", B.Sc. Thesis, (Adnan Sarker Apon), Department of Disaster Management, Begum Rokeya University, Sept., 2019.
76. Co-supervisor: Dr. Rahat Khan, "Accurate and Precise Analysis of Multi-Elements in IAEA Standard Reference Materials Using Neutron Irradiation and Gamma Spectroscopy", B.Sc. Thesis, (Laisee Lubna), Department of Nuclear Engineering, Faculty of Engineering & Technology, University of Dhaka, Jul., 2019.
77. Co-supervisor: Dr. Rahat Khan, "Determination of Elemental Concentrations in Biological Standard Reference Materials using Neutron Irradiation and Gamma Spectroscopy", B.Sc. Thesis, (Tazneen Islam Shaon), Department of Nuclear Engineering, Faculty of Engineering & Technology, University of Dhaka, Jul., 2019.
78. Co-supervisor: Dr. Shahzad Hossain, "Study of the Research Facilities at Neutron Scattering Group of RNPD and Brief Overview of Structural Refinement Procedure", B. Sc. Internship, (Md. Monirul Islam, Md. Al-Amin, Aminul Islam, Md. Rabiul Islam), Department of Chemistry, Mawlana Bhashani Science and Technology University, Jul., 2019.
79. Co-supervisor: Dr. Shahzad Hossain, "Development of Novel Electrolytes for Intermediate Temperature Solid Oxide Fuel Cells", PhD Thesis, (Ahmed Afif Bin Abedin), Department of Energy System Engineering, Faculty of Integrated Technologies, University of Brunei Darussalam, Brunei Darussalam, 2020.

80. Co-supervisor: Dr. Shahzad Hossain, "Synthesis and Structural Studies of Copper Doped Barium Zirconium Cerate for Application in Solid Oxide Fuel Cell", M. S. Thesis, (Md. Sydur Rahman Bappy), Department of Physics, University of Dhaka, Feb., 2020.

81. Co-supervisor: Dr. Shahzad Hossain, "Structural and Thermal Characterizations of $SrNd_{0.65}Zr_{0.35}O_{3-\delta}$ for Application in Solid Oxide Fuel Cells", M. S. Thesis, (Md. Maznu Mia), Department of Physics, University of Dhaka, Feb., 2020.

INSTITUTE OF FOOD AND RADIATION BIOLOGY (IFRB), AERE

Agrochemical and Environmental Research Division, IFRB

82. Supervisor/Co- Supervisor: Dr. Md. Amin Uddin, "Pesticide Residue Analysis in Water of Some Selected Ponds and Canals at Potuakhali and Borguna Districts", M.S thesis (Mohsin Iqbal), Department of Biochemistry & Molecular Biology, National University, Apr., 2019.

Insect Biotechnology Division, IFRB

83. Co-supervisor: Dr. M A Hossain, "Cytochrome c Oxidase Subunit I (*COI*) Based Molecular Identification and Characterization of Tephritid Fruit Flies (Diptera: Tephritidae)", M. Sc. Thesis, (Sumita Rani Das), Department of Zoology, Jahangirnagar University, Jan., 2020).

Microbiology and Industrial Irradiation Division, IFRB

84. Supervisor/Co- Supervisor: Dr Tabassum Mumtaz, "Isolation and Screening of Bioplastics (polyhydroxyalkanoates) Producing Bacteria and Yeasts from locally and commercially Available Whey", MS Thesis (Shishita Jahan Zisha), Dept of Environmental Sciences, Jahangirnagar University, Savar, Dhaka-1342, Bangladesh, Jul., 2019.

85. Supervisor/Co- Supervisor: Dr Tabassum Mumtaz, "Anaerobic Digestion of Kitchen Waste Generated from Atomic Energy Research Establishment (AERE) Cafeteria, Savar for Lactic Acid Production", M.Sc thesis (Syful Islam), Department of Microbiology, Noakhali Science and Technology University, Noakhali-3814, Bangladesh, Nov., 2019.

Food Safety and Quality Analysis Division, IFRB

Two thesis work(s) have been jointly completed in collaboration with HPRWM, INST

INSTITUTE OF TISSUE BANKING AND BIOMATERIALS RESEARCH (ITBBR), AERE

86. Supervis**o:** Dr. S. M. Asaduzzaman, "Characterization of Multidrug Resistant Bacteria Isolated from Burn Patients and Assessment of Antimicrobial Activity of Human Amniotic Membrane", M.S. Thesis **(**Tasrif Al Mosharaf), Department of Biotechnology and genetic engineering, Islamic University, Dec., 2019.

87. Supervisor: Dr. S. M. Asaduzzaman, "Study on the fabrication, optimization of processing parameters and characterization of collagen based vascularized scaffolds for biomedical application", M.S. Thesis (Rashed Hasan Nayeem), Department of Biotechnology and genetic engineering, Khulna University, Sept., 2019.

88. Supervisor: Dr. S. M. Asaduzzaman, **"**Characterization and *in vivo* Evaluation of Amniotic Membrane and Collagen Based Hydrogel in Rat Model", M.S. Thesis, **(**Md. Akib Ullah), Department of Biotechnology and genetic engineering, Khulna University, Sept., 2019.

INSTITUTE OF ELECTRONICS (IE), AERE

Solar Cell Fabrication and Research Division, IE

89. Joint-Supervisor Name: Mohammad Khairul Basher, "Study the Morphological and Structural Properties of Unirradiated ZnOnaro Rods and Gamma Irradiated ZnOnano-Rod Produced by the Hot-water Treatment Method", MS Thesis (Mahmudul Hasan), Institute of Energy, University of Dhaka. Sept., 2019.

NATIONAL INSTITUTE OF NUCLEAR MEDICINE AND ALLIED SCIENCES (NINMAS)

90. Co-supervisor: Prof. Ferdoushi Begum, "Evaluation of Internal Exposure of Nuclear Medicine Personnel in NINMAS, Dhaka through in vivo and in vitro Bioassay Techniques", M.Sc. Thesis (Sharmin Jahan), Department of Nuclear Engineering, Faculty of Engineering and Technology, University of Dhaka, Dhaka, Bangladesh, Dec., 2019.
91. Co-supervisor: Prof. Ferdoushi Begum, "Assessment of Environmental Toxicity of Some Waterfall Areas of Bangladesh by PIXE Technique and Radionuclides Detection Using Gamma Spectrometry", Ph. D. (Md. Shafiul Islam) Department of Physics, Jahangirnagar University, Savar, Dhaka, Bangladesh, Jan., 2020.

NUCLEAR SAFETY, SECURITY AND SAFEGUARDS DIVISION (NSSSD), HQ

92. Co-supervisor: Dr. Md. Shakilur Rahman and Tanjim Siddique, "Measurement of Computed Tomography (CT) Dose and Estimated Radiological Risk of Cancer", M.Sc. Thesis (Tapas Chandra Das), Department of Physics, University of Chittagong, Feb., 2020.
93. Co-supervisor: Dr. Md. Shakilur Rahman and Tanjim Siddique, "Standardization of calibration photon beam of radiation measuring devices used for radiation protection in Bangladesh", M. Sc Thesis (*Zohora Akther Mitu*), Department of Physics, University of Chittagong, 2020
94. Supervisor: Dr. Md. Shakilur Rahman, Joint-supervisor: Tanjim Siddique, "Absorbed Dose to Water Measurement of 60 Co Teletherapy Units Using IAEA Dosimetry Protocols", M. Sc Thesis (Md. Minhaj Hossain), Department of Physics, University of Chittagong, February 2020.
95. Co-supervisor: Dr. Md. Shakilur Rahman, "Determination of Cancer Risks Associated with External Radiation from Medical Diagnostic Computed Tomography (CT) Procedure", M.Phil (Imrose Jahan), Jahangirnagar University, Dec., 2019.

NUCLEAR MEDICAL PHYSICS INSTITUTE (NMPI), AERE

96. Co-supervisor: Hossen Mohammad Jamil, "Quality Control of Ct Image Using System Performance Phantom In Bangladesh", M. Sc. (Md. Rubel Hosen, Roll No. 14114438), Dept. of Physics, University of Rajshahi, Dec., 2019.

XV. INTERNATIONAL/NATIONAL PUBLICATIONS

ATOMIC ENERGY CENTRE (AEC), DHAKA

Chemistry Division, AECD

International

1. M. A. Rakib, J. Sasaki, H. Matsuda, S. B. Quraishi, M. J. Mahmud, M. Bodrud-Doza, A. A. Ullah, K. J. Fatema, M. A. Newaz and M. A. Bhuiyan, "Groundwater Salinization and Associated Co-contamination Risk Increase Severe Drinking Water Vulnerabilities in the Southwestern Coast of Bangladesh", Chemosphere, **246,** 125646 (2020).
2. M. Bodrud-Doza, S. D. U. Islam, T. Rume, S. B. Quraishi, M. S. Rahman and M. A. H. Bhuiyan, "Groundwater Quality and Human Health Risk Assessment for Safe and Sustainable Water Supply of Dhaka City Dwellers in Bangladesh", Groundwater for Sustainable Development, **10,** 100374 (2020).
3. A. K. M. A. Ullah, M. Akter, M. Musarrat and S. B. Quraishi, "Evaluation of Possible Human Health Risk of Heavy Metals from the Consumption of Two Marine Fish Species Tenualosa ilisha and Dorosoma cepedianum", Biological trace element research, **191,** 485-494 (2019).
4. M. Bodrud-Doza, M. A. H. Bhuiyan, S. D. U. Islam, S. B. Quraishi, M. I. Muhib, M. A. Rakib and M. S. Rahman, "Delineation of Trace Metals Contamination in Groundwater Using Geostatistical Techniques: A study on Dhaka City of Bangladesh", Groundwater for Sustainable Development, **9**, 100212 (2019).
5. A. K. M. A. Ullah, M. A. Maksud, S. R. Khan and S. B. Quraishi, 2019. "Morning (first) Urine Copper Concentration: A New Approach for the Diagnosis of Wilson's Disease", Biological trace element research, 190: 283-288.

6. N. Choudhury, S. B. Quraishi, A. K. M. Atiqullah, M. S. I. Khan, M. A. Mahtab and S. M. Akbar, "High Prevalence of Wilson's Diseases with Low Prevalence of Kayser–Fleischer Rings among Patients with Cryptogenic Chronic Liver Diseases in Bangladesh", Euroasian Journal of Hepato-gastroenterology, **9,** 6 (2019).

7. Y. N. Jolly, A. Kabir, S. Akter, A. M. S. Chowdhury, "Contamination status of Water, Fish and Vegetable Samples Collected from a Heavy Industrial Area and Possible health Risk Assessment", Food Technology nd Nutritional Sciences, **5(2),** 73-83 (2019).

8. M. Z. Amin, K. N. Tomu, M. Munshi, Y. N. Jolly, M. M. Rahman, M. A. Satter, "Assessment of Heavy Metal Contents in Commercial Feedstuffs and Broiler (Gallus Domestics) Meat and Its Impact on Swiss Albino Mices as an Animal Model", Agricultural Sciences Digest-A Research Journal, **39(2),** 149-155 (2019).

9. T. Rahman, S. Akter, Y. N. Jolly and M. G. Murtoza, "Heavy Metal Contamination of Some Fresh Water Fishes: A Market Based Study to Highlight the Possible Health Risk", Rajshahi University Zoological Society, 37, 23-27 (publihed in 2019).

10. A. R. M. T. Islam, M. Bodrud-Doza, M. S. Rahman, S. B. Amin, R. Chu and H. A. Mamun, "Sources of Trace Elements Identification in Drinking Water of Rangpur District, Bangladesh and Their Potential Health Risk Following Multivariate Techniques and Monte-Carlo simulation", Groundwater for Sustainable Development, **9**, (Oct. 2019), doi.org/10.1016/j.gsd.2019.100275.

11. M. S. Hossain, M. K. Ahmed, S. Sarker and M. S. Rahman, "Seasonal Variations of Trace Metals from Water and Sediment Samples in the Northern Bay of Bengal", Ecotoxicology and Environmental Safety, **193,**110347 (2020).

12. M. A. Baki, M. F. H. Shojib, S. Sehrin, S. Chakraborty, T. R. Choudhury, M. S. Bristy, M. K. Ahmed, S. B. Yusoff and M. F. Khan, "Health Risk Assessment of Heavy Metal Accumulation in the Buriganga and Turag River Systems for Puntius Ticto, Heteropneustes Fossilis, and Channa Punctatus", Environ Geochem Health, **42,** 531-543 ((2020), doi.org/10.1007/s10653-019-00386-4.

13. T. R. Choudhury, S. Bhowmik, M. S. Rahman, M. R. Nath, F. N. Jahan, B. A. Begum, M. Nurnabi, "Sythesis of Nano Zerovalent Iron Supported Sawdust (NZVI/SD) and Its Application for Removal of Arsenic (III) from Aqueous Solution", Chemical Science International Journal, **29(1)**, 1-12 (2020), doi: 10.9734/CSJI/2020/v29i130152.

14. T. R. Choudhury, U. H. B. Naher, S. Akter, B. A. Begum, M. S. Rahman, "Chromium (III) Removal from Synthetic Wastewater Using Biochar Produced from Vegetable Tanned Leather Shaving Dust", Journal of Scientific Research & Reports, **26(4)**, 68-80 (2020), doi: 10.9734/JSRR/2020/v26i430249.

15. S. Nandy, A. K. M. A. Morshed, T. I Chowdhury, S. Islam, B. K. Paul, S. Bhowmik, T. R. Choudhury, "Quantitative Assessment of Serum Copper Status in Children with Thalassemia Major", Current Journal of Applied Science and Technology, **39(13),** 94-100 (2020), doi:10.9734/CJAST/2020/ v39i1330685.5

16. M. M. Zaman, M. A. S. Karal, M. N. I. Khan, A. R. M. Tareq, S. Ahammed, M. Akter, A. Hossain and A. K. M. A. Ullah, "Eco-Friendly Synthesis of Fe_3O_4 Nanoparticles Based on Natural Stabilizer and Their Antibacterial Applications", Chemistry Select, **4,** 7824 - 7831 (July 2019).

17. A. K. M. Asaduzzaman, I. Hasan, M. H. Rahman, and A. R. M. Tareq, "Antioxidant and Antiproliferative Activity of Phytoconstituents Identified from Sargassum binderi Seaweed Extracts Cultivated in Bangladesh", International Journal of Biosciences, **19,** 481-494 (2020).

18. T. R. Tusher, M. E. Sarker, S. Nasrin, T. Kormoker, R. Proshad, M. S. Islam, S. A. Mamun and A. R. M. Tareq, " Contamination of Toxic Metals and Polycyclic Aromatics Hydrocarbons (PAHs) in Rooftop Vegetables and Human Health Risks in Bangladesh", Toxin Review, (Online Published May, 2020).

19. M. A. S. Karal, S. Ahammed, V. Levadny, M. Belaya, M. K. Ahamed, M. K. Ahmed, Z. B. Mahbub, and A. K. M. A. Ullah, "Deformation and Poration of Giant Unilamellar Vesicles Induced by Anionic Nanoparticles", Chemistry and Physics of Lipids, **230:** 104916 (2020).

20. A. Hossain, A. K. M. A. Ullah, P. S. Guin and S. Roy, "An Overview of La 2 NiMnO 6 Double Perovskites: Synthesis, Structure, Properties and Applications", Journal of Sol-Gel Science and Technology**, 93,** 479-494 (2020).

21. A. K. M. A. Ullah, M. M. Haque, M. Akter, A. A. Hossain, A. N. Tamanna, M. M. Hosen, A. K. M. F. Kibria, M. N. I. Khan and M. K. Khan, "Mediated Bio-molecule Capped Dilute Ferromagnetic α-MnO 2 Nanoparticles", Materials Research Express, **7,** 015088 (January 2020).
22. A. Hossain, K. Sakthipandi, A. K. M. A. Ullah and S. Roy, "Recent Progress and Approaches on Carbon-Free Energy from Water Splitting. Nano-Micro Letters", **11**, 103 (Nov. 2019).
23. M. Akter, A. K. M. A. Ullah, M. S. Rahaman, M. M. Rahman, M. T. Sikder, T. Hosokawa, T. Saito and M. Kurasaki, "Stability Enhancement of Silver Nanoparticles Through Surface Encapsulation via a Facile Green Synthesis Approach and Toxicity Reduction", Journal of Inorganic and Organometallic Polymers and Materials, **30**, 1956–1965 (2020).
24. T. I. Chowdhury and T. R. Choudhury, "Association of Foetal Outcome with Maternal Body Mass Index (BMI)", International Journal of TROPICAL DISEASE & Health, **41(5),** 65-76 (2020), doi: 10.9734/IJTDH/2020/v41i53028.

Accelerator Facilities Division, AECD

International

25. L. Zaman, S. M. A. Islam, M. J. Abedin, "Detection and Analysis of Radionuclides Accumulated in Soil of Cox's Bazar Sea Beach Area using Gamma Spectroscopy System", International Journal of Engineering Innovation & Research, **8(5)** (Sept. 2019), ISSN: 2277 – 5668.

Electronics Division, AECD

International

26. A. Rahman, S. Sarker, M. A. Habib, M. A. A. Mamun, S. Sattar, M. Begum, and M. S. S. Chowdhury, "PC Based Wireless Remote Monitoring System for Photovoltaic (PV) Panel Efficiency Analysis", American Journal of Engineering Research, **8(8),** 111-117 (Aug. 2019).
27. M. A. A. Mamun, M. A. Rahman, S. Sattar, and M. Begum, "Microcontroller Based Multichannel Data Acquisition System using LabVIEW", International Journal of Recent Technology and Engineering, **8(2),** 6539-6543 (2019).
28. M. Begum, M. A. A. Mamun, M. A. Rahman, and S. Sattar, "Customized DC Power Supply for Electrodeposition Technique in Alpha Spectrometry System", Australian Journal of Science and Technology, **3(3),** (Sept., 2019).
29. M. S. S. Chowdhury, M. A. Rashid, M. A. Rahman and A. Z. Z. Ahmed, "Study of Energy of Formation for Fe_xNi_{1-x} Liquid Binary Alloys", Asian Journal of Research and Reviews in Physics, **2(4),** 1-12 (Aug. 2019), Article no.AJR2P.50786
30. M. A. Rahman, M. A. A. Mamun, S. Sattar, M. Begum and A. Begum "Automatic Room Conditioning System for Mass Production of Fruit-fly", International Journal of Advanced Science and Technology, **135,** 63-72 (Feb. 2020).
31. M. N. Islam, H. Akhter, M. Begum, M. S. Alam and M. Kamal, "Study of Radiation Interaction Mechanisms of Different Nuclear Detectors", Int. J. of Adv. Eng., Mgt. and Sci. (IJAEMS), ISSN: 2454-1311, Infogain Publication, **5(7),** 471-474 (Jul. 2019), 10.22161/ijaems.577.

Experimental Physics Division, AECD

International

32. K. M. A. Hussain, M. S. S. Chowdhury, "Substrates Effects on CdTe Thin Films Using Double Layer Thermal Evaporation", Journal of Nanoscience, Nanoengineering and Applications, **9(2)**, 64-70 (Sept. 2019), ISSN: 2231-1777 (Online), ISSN: 2321-5194 (Print)
33. M. A. Hussain, M. S. S. Chowdhury, T. Faruqe, "Study of CdS/AZO/FTO, CdS/FTO and Thin Films Deposited by Modified Double Layer Thermal Evaporation", Journal of Nanoscience, Nanoengineering and Applications, **9(2),** 56-63 (Sept. 2019), ISSN: 2231-1777 (Online), ISSN: 2321-5194 (Print).
34. N. Esha, M. Al-Amin, F. T. Z. Toma, E. Hossain, M. N. I. Khan and K. H. Maria, "Synthesis and Analysis of the Influence of Eu^{3+} on the Structural, Ferromagnetic, Dielectric and Conductive Characteristics of $Ni_{0.4}Zn_{0.45}Cu_{0.15}Fe_{(2-x)}Eu_xO_4$ Composites using Conventional Double Sintering Ceramic Method", Journal of Ceramic Processing Research, **20(5)**. 530-539 (Nov. 2019).

Health Physics Division, AECD

International

35. M. S. Mian, M. S. Rahman, J. Islam, K. N. Sakib, M. M. Tasnim and S. Yeasmin, "In-Situ Environmental Gamma Radiation Monitoring at Ramna Thana, Dhaka, Bangladesh", Journal of Scientific Research, **11(3),** 263-272 (Sept. 2019).
36. M. D. Huda, M. S. Rahman, J. Islam, K. N. Sakib, M. M. Tasnim and S. Yeasmin, "Radiation Monitoring and Evaluation of Risk to Population in Mitford Hospital, Dhaka, Bangladesh", ABC Research Alert, **7(3)**, 148-154 (Sept. 2019).
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XVI. PAPER PRESENTED IN SEMINAR/SYMPOSIUM/ CONFERENCE/WORKSHOP

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280. "BMD-Clinical applications", A. K. Paul, Scientifrc Seminar arranged by KMCH, 03 Oct., 2019.
281. "Treatrnent of Ca Thyroid", J. Das, Monthly Scientific Seminar arranged by KMCH, 02 Jan., 2020.
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284. "A study on radioactive contamination of sediments along the coasts of Feni River", S. Zaman, M. Debnath, N. S. Resma, M. Ahmed, S. R. Talukder, S. Hossain, S. R. Chakraborty, International conference on Physics, organized by Bangladesh Physical Society, AECD, 5-7 Mar., 2020, pp. 52-53.
285. "Para rubber membrane - a novel lure matrix, impregnated with methyl eugenol for the mass trapping of Bactrocera dorsalis (Hendel) and Bactrocera zonata (Saunders)", M. Khan, N. Khatun, M. S. Uddin, S. Sultana and N. C. Dafader, 21st International Biennial Conference and AGM, organized by Bangladesh Zoological Society (ZSB), 2019, pp. 97.
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287. "Radioactive and rare earth containing materials in beach minerals of Bangladesh: a SEM study", M. Rajib and Oguchi, International Conference on Earth & Environmental Sciences and Technology, 25-30 Jan., 2020, pp. 134-140.
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291. "Updates in Nuclear Medicine: Services delivered at INMAS-Rajshahi", M. S. Ahsan, Scientific Seminar, organized by INMAS Rajshahi at Amiruddin Gallery, RMC, 26 Oct., 2019.

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