ANNUAL REPORT

July 2021 – June 2022

BANGLADESH ATOMIC ENERGY COMMISSION

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EDITORIAL BOARD

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Introduction

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

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

The R & D programmes of BAEC are executed through its different institutes, centres. The laboratories of all the institute/centres are equipped with state-of the-art facilities. The major facilities include 3 MW BTRR, 3MV Tandem Accelerator Facility, 3MV Van de Graff Accelerator, Two Co-60 gamma irradiator, Central Radioactive Waste Processing and Storage Facilities, Nuclear apparatus and scanning devices in National Institute of Nuclear Medicine and Allied Sciences (NINMAS) and 14 Institute of Nuclear Medicine and Allied Sciences (INMAS) located at different district headquarters, Radioisotope Production Laboratory, Radioactivity Testing and Monitoring Laboratory, air particle monitoring facility, beach sand minerals processing pilot plant etc. Apart from R & D activities, the following divisions of BAEC are playing vital role in executing various programmes.

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

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

Scientific Information Division (SID): This division is responsible for selection, collection, processing and providing information to a wide range of stakeholders concerned with the R & D activities and different services of BAEC.

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 Jul. 2021 to Jun. 2022 in the various fields of nuclear science and technology have been included in this report.

RESEARCH & DEVELOPMENT AND SERVICE ACTIVITIES

I. PHYSICAL SCIENCES

ATOMIC ENERGY CENTRE (AEC), DHAKA

Chemistry Division, AECD

Objective

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

Programme

The Chemistry Division of Atomic Energy Centre, Dhaka is recognized both nationally and internationally as one of the leading Research Hubs in the field of Chemistry with particular focus on Analytical Chemistry. As we have entered the new millennium, the demand for quality assured chemical analysis in samples of different description is ever increasing. Rising up to that demand, the laboratories in the Chemistry Division has been making significant contribution towards he scientific advancement and the socio-economic development of Bangladesh through different R&D programmes 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 programmes. Along with all of these, the chemistry division is a regular participant in coordinated research programmes under IAEA/RCA framework and a constant winner of research projects under MOST special grant programme, particularly in the field of environmental pollution, nuclear analytical techniques in material analysis and environmental studies.

Activities

1. Research and Development Work(S)

Advanced Analytical Chemistry

1.1 Participation in Proficiency Testing on Environmental Surface Water Chemistry, SW013 Organized by FAPAS

S. B. Quraishi, T. R. Choudhury, K. J. Fatema, M. N. Alam, 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 the instruments.Therefore, the main objective of this programme 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 'Proficiency Testing on Environmental Surface Water Chemistry, SW013' by FAPAS, UK for the analysis of target analytes including physiochemical parameters, metals and ions e.g. pH, Conductivity, Ca, Mg, Na, K, Cl^-, SO_4^{2-}, F^-, NO_2^-, NO_3^- in surface water. The laboratory has secured satisfactory results for the quantification of the analytes quantified by different forms of Atomic Absorption Spectrophotometry (AAS) and other instruments/ techniques. The results indicate the capability of the laboratory to provide quality data for the quantification of trace elements in different food samples.

1.2 Renewal of Accreditation Certificate of Analytical Chemistry Laboratory

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

Quality assurance is a crucial part of any research and service activities and accreditation by a reliable body is a recognition of high performance as well as a criterionto offer trustable quality service. In Bangladesh,

Bangladesh Accreditation Board (BAB) is the authorized body to issue accreditation certificate. ACL has achieved ISO/IEC 17025:2005 certification from BAB in 2015 and has upheld its accreditation status continuously. The main objective of this programme was to renewal of the certification as well as inclusion of new test methods/scopes under the accreditation scheme.In light of application for renewal of accreditation status from the laboratory with the proof of upgradation of relevant documentation, management and internal policy an assessment team from Bangladesh Accreditation Board (BAB) has visited the laboratory, reviewed the laboratory activities and performance and gave their observations along with various suggestions. The lab has acted accordingly through various upgradations in internal arrangement and policy, submitted the relevant documents and has received the newly issued ISO/IEC 17025:2017 certificate. In the mean time, several new methods including analysis of heavy metals e.g. Pb, Cd, Cr, As, Hg etc. in food items and soil, analysis of Cu in urine to detect the presence of Wilsons disease has received accreditation from BAB extending the total number of scope of the laboratory under accreditation 53.

1.3 Soil, Dust, and Leaf-Based Novel Multi-Sample Approach for Urban Heavy Metal Contamination Appraisals in A Megacity, Dhaka, Bangladesh

T. R. Choudhury, M. B. Sultan*, M. N. Alam, M. M. Hosen, M. A. Maksud, S. R. Khan, L. N. Lutfa, M. M Rahman* and S. B. Quraishi

The fast-growing megacities in the South Asian region have been facing environmental issues such as heavy metal load due to anthropogenic activities including Dhaka city. Thus, this study was executed to understand the heavy metal contamination in the urban environment using a novel multi-sample (soil, dust, and tree leaves) approach in Dhaka city, Bangladesh.In this study, 13 sites were selected for the analysis of nine heavy metals using AAS. The concentration (ppm) of Cd (4.95± 0.06), Zn (254±8.0), Cu (56.25± 0.06), and Mn (995.9±0.0) in the soil and Cr (135.50±5.00), Ni (68.35 ±1.30), Zn (275.73 ±6.00), Cu (68.35± 1.30) and Mn (1076±84) in the dust exceeded the maximum permissible limit. In tree leaf samples except for Ni all the heavy metals exceeded the standard value. Environmental pollution indices revealed that the study area is mostly contaminated with Cu, Pb, Ni, Zn, Cd, Mn, and Cr. Vehicle emissions were recognized as the major source of Zn, Cu, Pb, Ni in soil; Cr, Pb, Mn, Zn in the dust; and Ni, Mn, Pb, Zn in tree leaves, according to the multivariate statisticalanalysis. Industrial emissions were identified as the primary source of Cd in soil, Cu, Cd, Ni in dust, and Cr, Cd in tree leaves. However, the analysis of metals in tree leaves among five species Ficus aurea, Ficus benghalensis, Ficus religiosa, Ficus rubiginosa, and Polyalthia longifolia revealed that Ficus aurea is a hyperaccumulator of Cd and good accumulator for other metals, making it a suitable candidate for urban greening. Polyalthia longifolia is a better barrier of toxic elements. Cr possesses the highest carcinogenic risk for the inhabitants and Cd was found to cause the highest potential ecological risk. Metals in each sample type in each sampling site reveal almost a nonpareil relationship that indicates the appraisal of the multi-sample approach. Therefore, it can be said that this scientific study provides an effective tool for assessing urban metal pollution.

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1.4 Synthesis and Characterization of Graphene Oxide for Removal of Cr (III) From Tannery Effluent

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

Chromium released with tannery effluent causes severe water pollution which is a great concern to the environment and public health. Removal of chromium from tannery effluent prior to discharging to the surface water is a crying need for protecting environment and human health. This study aimed the preparation and characterization of graphene oxide (GO) and its adsorption potential for Cr (III) from hazardous chrome-tanning effluents. GO was characterized by X-ray diffraction analysis, field emission scanning electron microscopy, Fourier transform infrared spectroscopy, and Zeta potential measurement. Explanation of the adsorption mechanism, kinetics, and feasibility were also studied. The influence of different operational variables, for example, pH, adsorbent dosage, Cr(III) ion concentration, contact time, and temperature on adsorption of Cr(III) on GO were evaluated by batch experiments. Adsorption equilibrium of Cr(III) data matched with both Langmuir and Freundlich isotherms and the maximum adsorption capacity (qm) was calculated from Langmuir isotherm and found as 366.3 mg/g. Cr(III) and other pollutants removal efficiency

of GO was studied for the real effluent sample having Cr(III) concentration of 3,477.5 mg/L. At a GO dosage of 1.0 g/100 mL 51.88% Cr(III) was removed in just 20 min of treatment, while biochemical oxygen demand, chemical oxygen demand, and total dissolved solids removal was 57.93%, 55.41%, and 61.4%, respectively. The adsorption kinetics fitted well with a pseudo-second-order reaction model and thermodynamically it was spontaneous at lower temperature and exothermic in nature. Cr(III) loaded adsorbent was regenerated and reused for further adsorption.

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1.5 Development of Nanoadsorbents for Efficient Arsenic Removal from Drinking Water

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

The presence of arsenic in groundwater, either from anthropogenic or natural sources, is a serious problem in many different parts of the world. In Bangladesh, ground water used for drinking purpose has been highly contaminated with naturally occurring inorganic arsenic. The purpose of the study wasto synthesis nanoadsorbents for arsenic removal from water and to evaluate the potential reuse of the adsorbent.In this study, we have synthesized GO, ZnO and TiO_2. GO was prepared by modified Hummers' method. Briefly, graphite powder (3.0 g) was added to a mixture (75 mL) of concentrated H_2SO_4 and concentrated HNO_3 (3:1) in a round bottom flask immersed in a water bath with vigorous stirring to form a homogeneous suspension, followed by addition of $KMnO_4$ (9.0 g) and $NaNO_3$ (1.5 g) slowly to the flask and left for overnight under stirring in a magnetic stirrer to yielded a thick paste. Then deionized water (120 mL) was added to it and stirred for 4 h in a bath at 35°C. A deep brown reaction mixture was produced, which was washed with deionized water (420 mL) followed by the addition of 30% H_2O_2 (20 mL) to produce a bright yellow mixture. Finally, 5% HCl (200 mL) was added to remove Mn2+ ions from the prepared graphene oxide and washed by adding deionized water followed by centrifugation at 5,000 rpm. Washing step was repeated several times until the pH of the solution was 7.0. Graphene oxide (GO) was characterized by scanning electron microscopy (SEM), X-Ray Diffraction (XRD) analysis, Fourier Transform Infrared (FTIR) Spectroscopy, Raman spectroscopy and Thermo Gravimetric Analysis (TGA). The work is in progress.

1.6 Heavy Metal Contamination and Health Risk Assessment of Road Dust from Landfills in Dhaka and Narayanganj

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Street dust, from the lan d fills area are the most important carriers of heavy metal contaminants usually considered as a valuable indicator of the air quality in an urban environment. This study was thus carried out to investigate the factors and processes controlling the airborne transferof toxic metals in dust, and their possible link to metal pollution. In this study, concentrations of heavy metals such as Pb, Cd, Cr, As, Cu, Ni, Zn and Mn were determined in road dusts collected from four landfill sites in Dhaka and Narayanganj to assess the contamination status and health risk. To evaluate the degree of accumulation of the heavy metals into the dust particles, the dust samples were sieved into three sizes: <300 - >150, <150 - >75 and <75 μm. Atomic absorption spectroscopy (AAS) was used to determine the concentrations of these heavy metals in the dust samples. The highest concentrations of Pb and As were found at Matuail landfills site, whereas Cd, Cr, Zn and Mn were found with their highest concentrations at Narayanganj landfills site. Concentration of Cu followed by Ni were found at elevated levels at Matuail medical waste incineration plant. According to the size-dependent results, the finer particles (<75 μm) had a higher degree of heavy metal accumulation. Height dependent results showed that the finer particles were deposited upright on the tree leaves. According to pollution load index, Matuail area quality was extremely degraded. For noncarcinogenic health risk, hazard quotient values for ingestion were higher compared to that of inhalation and dermal pathways. Hazard index values of Matuail landfills and medical waste incineration sites (M-7 and M-13) were more than 1 for adult groups, where hazard index values for children group of sites M-7, M-13 and M-17 (Narayanganj landfills) were more than 1 and these were at least one order of magnitude higher than that of adult group. The results revealed that the children group may face more noncarcinogenic health risks at these sites.

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1.7 Preparation of Calcium Alginate-Graphene Oxide Composite and Its Application for The Removal of Chromium, Cadmium and Copper

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Due to the rapid growth of tannery industries and pollution-provoking factories, it has become mandatory to realise the perilous reactions of toxic organic compounds and heavy metal ions in the water resources and take drastic steps to remove such pollutions from water to save mankind and environment. The aim of this study was preparation of non-dispersible calcium alginate-graphene oxide (CA-GO) composite, its characterization and application for adsorption of Cr(III), Cu(II) and Cd(II). The CA-GO composite was prepared by adding a mixture of GO with sodium alginate and $CaCO_3$ (SA: CaCO 3: GO = 10:2.5: 1) to 2% HCl. The prepared composite was characterised by SEM, XRD and FTIR analysis. The surface charge of the composite was also determined by zeta potential analysis. The adsorption properties of the composite were investigated for removal of Cr(III), Cu(II) and Cd(II) from industrial effluent. Effects of concentration, contact time, adsorbent dosage, pH and temperature on adsorption capacity of the composite were studied. The equilibrium of the process preferably followed Langmuir and Freundlich isotherm models and revealed that the R^2 value of Langmuir isotherm was 0.993, 0.996 and 0.975 and Freundlich isotherm was 0.992, 0.998 and 0.992 for Cr(III), Cu(II) and Cd(II)adsorption, respectively. The work is in progress.

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1.8 Low-cost synthesis of Silver Nanoparticles (AgNPs) using *Corchorus Capsularis* Leaves and Their Characterization Study

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

Having unique physical and chemical properties, silver nanoparticles (AgNPs) are widely used in biomedicine. Ag NPs are also used in some other various fields such as medical, food, health care, consumer, and industrial purposes. Ag NPs have broad-spectrum antimicrobial properties against pathogenic bacteria.. Our research target is to synthesis of silver nanoparticles (AgNPs) and their characterization and to realize their future possible use to using *Corchorus capsularis* with as low cost as possible. Being ecofriendly, nonhazardous and having cost effectiveness advancement over physical and chemical methods, green methods are safe, one step, and simple and did not require any chemical reducing and stabilizing agents. We use *Corchorus capsularis* leaf extract for the synthesis of silver nanoparticles (AgNPs). *Corchorus capsularis* were collected from nearby market. The leaf was washed by deionized water for here times. Clean leaves were dried in an oven at 60^oC and then crushed as leaf fine powder using mortar and pestle. 5.0 g fine leaf powder was added to 200 mL deionized water and then heated to 80^oC for 30 minutes. The mixture was stirred continuously with a stirrer and hot plate during heating to keep the mixture uniform so that the maximum collision between water and leaves powder to ensure maximum extraction of phytochemicals. After cooling the mixture was filtered, then leaves extract was added dropwise to 500mL of 15mM $AgNO_3$ solution. 80^oC temperature was maintained with continuous stirring using a hot plate. The addition was done until the color of the mixture turned to reddish black. The mixture was kept for 24 hours for sedimentation, then the sample was centrifuged for 30 minutes with 4000 rpm speed. The centrifuged sample washed for 4-5 times for proper cleaning of nanoparticles. The sample then dried at 120^oC and crushed using mortar and pestle to make fine powder. The powder stored in a clean vial for further characterization. The characterization of the synthesized Ag NPs was carried out using various techniques such as UV-visible (UV-Vis) spectroscopy, energy dispersive X-ray (EDX) spectroscopy, Fourier transform infrared (FT-IR) spectroscopy, transmission electron microscopy (TEM) analyses, confirm to the successful generation of silver nanoparticles (AgNPs).

1.9 Green Synthesis of Silver Nanoparticles (AgNPs) Using *Ziziphus Mauritiana* Leaves and Their Characterization

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

Silver nanoparticles (AgNPs) are widely used in biomedicine due to its unique properties. Basically, AgNPs are used in antimicrobial and anticancer therapy because of its antimicrobial properties against pathogens.Synthesis of silver nanoparticles (AgNPs) using biological materials such as plants to decrease the use of toxic chemicals is the main aim of green synthesis. Green synthesis is biologically safe, cost-effective,

and friendly to environment. Consequently, synthesis of Silver nanoparticles (AgNPs) with greener methods is preferred. Our aim is to develop a new greener method for the synthesis of using *Ziziphus mauritiana* leaves by reducing harmful by-products produced through the process of conventional synthesis of Silver nanoparticles (AgNPs). As plants leaves contain reducing and capping agents. Its extracts can be used as reducing agent in the synthesis process of Silver nanoparticles (AgNPs) *Ziziphus mauritiana* leaves extract is used here for the synthesis of silver nanoparticles (AgNPs).*Ziziphus mauritiana* leaves were collected from Dhaka University campus area. The leaves were washed by Distilled water for several times. Clean leaves were dried in an oven at 60^{o}C. Then the dried leaves were crushed to make fine powder using mortar and pestle. 5.0 g of fine powder and 200.0 mL Distilled water taken in a beaker and heated to 80^{o}C for 30 minutes. The mixture was stirred continuously with a stirrer and hot plate during heating to keep the mixture uniform so that the maximum collision between water and leaves powder to ensure maximum extraction of phytochemicals. After cooling the sample was filtered. The leaves extract drops wise added to 500mL 15mM $AgNO_3$ kept in a beaker. During addition 80^{o}C temperature was maintained with continuous stirring using a hot plate. The addition was done until the color of the mixture turned to reddish black. UV spectroscopy taken for the confirmation of the preparation of the of silver nanoparticles (AgNPs). The mixture was kept for 24 hours for sedimentation, then the sample was centrifuged for 30 minutes with 4000 rpm speed. The centrifuged sample washed for 4-5 times for proper cleaning of nanoparticles. The sample then dried at 120^{o}C and crushed using mortar and pestle to make fine powder. The powder stored in a clean vial for further characterization. UV, TEM and EDX have carried out to confirm the successful generation of silver nanoparticles (AgNPs).

Food Chemistry

1.10 Assessment of Human Health & Ecological Risks of Heavy Metal in Agricultural Soil and Vegetable of Dhaka District, Bangladesh

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

Vegetables are hailed as good food items and constitute a major part of our food chart. But, sometimes they are cultivated in waste laddden areas and thus have risk to sereve as a pathway of transferring heavy metals to our food chain. Thus it is essential to check the extent of presence of heavy metals in soil of the waste ladden areas and the vegetables grown on it and assess the risk associated with their consumption. The study was conducted to assess the concentrations of heavy metals in agricultural soil and vegetables (Vignaunguiculata, Raphanussativus, Carica papaya) along with the estimation of the associated human health and ecological risks of those metals. The Geoaccumulation Index (Igeo), Contamination Factor (Cf), Pollution Load Index (PLI), Potential Ecological Risk Index (PERI), Bioaccumulation Factor (BAF), Contamination Load Index (CLI), Chronic Daily Intake (EDI) through exposure pathway, Hazard Quotient (HQ), and Hazard Index were evaluated to access the ecological risk and human health risk. Total 36 soil and 36 vegetables samples were collected from three industrial areas (18 sampling sites) around the Dhaka city of Bangladesh in two months (Nov. 2021 and Mar. 2022). The mean(±SD) concentration of Pb, Cd, Cr, As, Cu, Ni, Mn and Zn in different agricultural soil were 89.16(±5.7), 0.27(±0.01), 65.35(±7.8), 5.13(±0.19), 33.71(±2), 317.05(±11.4), 472.53(±79.4), and 96.66±(13.5) mg/Kg, respectively in Nov. 2021. In Mar. 2021, the mean(±SD) content of Pb, Cd, Cr, As, Cu, Ni, Mn and Zn in different agricultural soil were 153.0(±9.18), 0.44(±0.02), 34.5(±4.09), 3.70±(0.21), 22.6±(1.36), 175(±6.3), 441(±74.2), 121.7(±17.0) mg/Kg, respectively. On the fresh weight basis, the mean(±SD) of Pb, Cd, Cr, As, Cu, Ni, Mn and Zn in different vegetables were (0.48±0.02), (0.04±0.001), (0.14±0.01), (0.01±0.0002), (0.62±0.03), (1.38±0.05), (2.27±0.18), (5.11±0.47) mg/Kg, respectively in Nov. 2021. The mean(±SD) content of Pb, Cd, Cr, As, Cu, Ni, Mn and Zn in vegetables were 0.16(±0.01), 5.25±(0.073), 1.20±(0.04), 0.003±(0.0001), 0.59±(0.03), 2.21±(0.08), 1.54±(0.12) and 2.67(±0.33) mg/Kg respectively, (fresh weight basis) in Mar. 2022.

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1.11 Estimation of Heavy Metals in The Fish from The Passur River of The Sundarbans Mangrove Forest

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Sundarban is the worls largest naturally grown mangrove forst. It has a unique environment supporting and harboring a huge number of animals and plants including endangered ones. With the aggression of heavy metal contamination commonly through water way and having the Passur river running through the forst, it is important to check the different components of the river system. Thus, this work was aimed to check the level of heavy metals curruently present in fish of the river collected from different points within the forest.The project is at its early stage. So far, fish samples of different size and type has been collected from 6 stations of Sundarbans along the Passur river. Initially, they have been stored intorefrizerator. They are being processed to be prepared for analysis.

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1.12 Apportionment of Carcinogenic Arsenic (III & IV) in Water using Atomic Absorption Spectrophotometer (AAS) and Estimation of Associated Human Health Risk

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

Arsenic in water mainly exist at +3 and +5 oxidation states. The level of toxicity is higher in case of the +3 state than that of +5 state. However, AAS usually measure the total amount by converting the whole amount to +3 state via reduction and health risk is estimated accordingly. If the reduction could be controlled by time variation during analysis, the relative amount of arsenic in different state could be assessed and consequently the associated risk could be truly assessed properly.Literature riview including the process of current method, its mechanism and possible areas of tuning has been completed. Accordingly necessary trial arrangements have been made. Sample collection has been designed.

1.13 A Probabilistic-deterministic Approach towards Human Health Risk Assessment and Source Apportionment of Potentially Toxic Elements (PTEs) in Some Contaminated Fish Species

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

Level of PTEs in the studied fish species were found within the legislative value suggested by World health organization (WHO) and Federal environmental protection agency (FEPA) except Fe, Cu, Zn Hg and can be assembled as Zn>Fe>Cu>Mn>Cr>Hg>As>Pb. The origin of PTEs in fish species apportioned mostly anthropogenic coupled with natural sources. This study identified children are exposed to As and Zn as their estimated targeted hazard quotient (THQ) value exceeded the threshold limit of safety, whereas adults are exposed to As only. The estimated, hazard index (HI) for children were found more than four times of adults, however, both the population groups are in vulnerable situation considering HI value (HI>1) and indicating possible non-carcinogenic health risk. Moreover, cumulative cancer risk TCR appraised that all the fish species exceeded the threshold limit of >1E-03 for children and >1E-04 for adults, which are level VII and level V contamination state for child and adult, respectively and manifested consumption of the studied fishes arise a high probability for lifetime cancer risk.

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1.14 Trace Element Bioaccumulation in Edible Red Seaweeds (Rhodophyta): A Risk Assessment for Consumers

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

Human uptake of Fe, Mn, Ni, Cu, Zn, Se, Hg, and As in the edible red seaweeds (Rhodophyta) Gelidium pusillum and Hypnea musciformis, growing in the industrialised Cox's Bazar coastal area of Bangladesh was evaluated in this study. Heavy metals were analysed using Energy Dispersive X-ray Flourescence (EDXRF). Metal and metalloid concentrations in G. pusillum were in the order (mg/kg): Fe (797 ± 67)>Mn (69 ± 4)> Ni (12 ± 5)>Zn (9 ± 4)>Cu (9 ± 4)>Se (0.1 ± 0.1)>Hg (0.1 ± 0.01), and in H. musciformis: Fe (668 ± 58) >Mn (28 ± 5)>Ni (14 ± 2)>Zn (11 ± 5)>Cu (6 ± 4)>Se (0.2 ± 0.03)>Hg (0.04 ± 0.01). Despite the industrial activities in the area, and based on 10 g. day− 1 seaweed consumption, it is concluded that these

concentrations pose no risk to human health as part of a normal diet according to the targeted hazard quotient and hazard index (THQ and HI) (values<1). In addition, and as a novel aspect for seaweeds, Selenium Health Benefit Values (Se-HBV) were determined and found to have positive values. Seaweed can be used as an absorber of inorganic metals for removing contamination in coastal waters.

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1.15 Evaluation of Heavy Metals in Sediment, Fishes and Other Aquatic Animals Collected from Bongshi River, Savar and Their Possible Health Risks Assessment

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

20 sediment samples and 6 aquatic animals were collected from the Bongshi river estuary for heavy metal analyses using EDXRF technique. To determine the pollution status in the sediments various pollution indices like Enrichment factor, Geoaccumulation index, Degree of contamination, Pollution load index and Ecological Risk assessment were done, moreover exposure to heavy metal via inhalation, ingestion and dermal contact were also estimate to evaluate contaminated sediment exposure to human health. Furthermore, health risk effect due to dieter consumption of aquatic animals for human health was also evaluated. The work is in progress.

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1.16 Trace and Heavy Metals in Powder Milk of Different Local Markets of Bangladesh and Possible Health Risk Assessment

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

25 Powder milk samples were collected from different local market Mohakhali, Gulshan and New marketof Dhaka, Bangladesh.As a result of analysis of the samples, the various concentrations of elements such as V, Cr, Mn, Fe, Co, Ni, Cu, Zn, Se, Rb, Sr, Hg and Pb were determined the heavy metals and toxic elements using the nuclear analytical technique EDXRF. Because pasteurization and sterilization processes may influence their elements. Cow's milk also collected from Dohar, Savar, Badda, Gazipur, Munshigonj, Mirpur and Jamalpur of Bangladesh were also analyzed in this study. The reliability of measured Analytical value were validated by certified reference milk powder (IAEA-153). In addition, the calculated values of metal pollution index (MPI), daily intake of metals (EDI), health risk index (HRI) and hazard index (HI) were lower than reference values.Hazard Quotients (HQ) values and Carcinogenic Risk (CR) values were found within the acceptable level.

1.17 Ecophysiological Responses of Selected Winter Legume Crops to Water Stress Conditions

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

Soil samples were collected from Botanical Garden of Dhaka University. Trace and Heavy metals K, Ca, Ti, Mn, Fe, Ni, Cu, Zn, Sr, Rb and Pb were determined using the nuclear analytical technique EDXRF available in Atmospheric and Environmental Laboratory of Chemistry Division, AECD. Legume crops play an important role in the ecosystem by working as a Nitrogen fixer. To maximize crop production with minimum input of water is a goal for tackling abiotic stress i.e water stress. We used various treatments to understand nutrient uptake in plants and their water use efficiency during water stress conditions. We tried to mitigate water stress by providing micronutrients as foliar spray. Sample preparation and sample irradiation are completed. Further works are in progress.

1.18 Exposure of Heavy Metals Via Dietary Intake of Some Commonly Consumed Marine Fishes Collected From The Shitakundo Ship Breaking Areas of Bangladesh

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

Present experiment enlightened on the determination of the level of some heavy metals (HMs) in fish samples and evaluating exposure level of health hazards of HMs in both children and adults due to consuming contaminated fishes, calculation of various indices using multivariate techniques with the special emphasis on possible sources apportionment of HMs was also performed. Heavy metal concentrations (i.e., Cr, Cu, Pb, Mn, Hg, Sn and As) in the collected fish species were determined using energy dispersive X-ray fluorescence (EDXRF) method. Human health risk has been estimated considering the metal concentrations in fishes in association of the estimated daily intake (EDI) of the studied heavy metals by human through oral reference

dose. Assessment of non-carcinogenic risk was also conducted through the target hazard quotient (THQ) equation. Subsequently, human health risk assessment was also conducted for this study through carcinogenic slope factor. Heavy metals concentrations in all the analyzed fish species from the study sites were generally low and safe for human consumption. Considering human health, the non-carcinogenic index (THQ) values indicated that there was no risk from fish consumption. On contrary, carcinogenic risk index (TR) for this study suggested that the studied fish species contained negligible carcinogenic health risk considering the US EPA's standard reference dose values (RfD), and daily metal intake amount through the consumption of selective fish species. It has been suggested that regular and long-term monitoring of the aquatic body and its fish species should be continued in the northern Bay of Bengal, especially near to the Shitakundo ship breaking industry.

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1.19 Bioaccumulation of Metals in Selected Cultured Fish Species and Human Health Risk Assessment: A Study in Mymensingh SadarUpazila, Bangladesh

B. A. Begum, P. Ghosh *, Z. Ahmed, R. Alam, S. Akter and Y. N. Jolly

This paper aims to measure the metals (Fe, Cu, Cr, Co, As, Zn, Hg, and Pb) concentration and assesses human health risks posed by these eight metals in the five most available cultured fish species (Pangasiuspangasius, Oreochromisniloticus, Heteropneustesfossilis, Anabustestudineus, Clariasbatrachus) collected from the MymenshingSadarUpazila. Both fishes and three fish feeds were analyzed using energy dispersive X-ray fluorescence (EDXRF). In fish feeds, the concentrations of metals were detected in the following order Fe>Zn>Cu>Hg>Pb. Besides, Hg concentration in three feeds samples was found higher than the maximum residue limit. Fe, Cu, Cr, Co, As, Zn, Hg, and Pb concentration in fishes were 82.45 to 104.55, 24.47 to 32.88, 2.62 to 6.73, < 0.28 <0.41, 70.01 to 96.56, 0.57 to 1.07 and 0.34 to 0.49 µg/g respectively as dry weight basis. Health Risk Index (HRI) was observed >1 both for adults and children and maximum HRI values for Pb was found in both P. pangasius and C. batrachus fish species.

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1.20 Trace Metals Contamination in Riverine Captured Fish and Prawn of Bangladesh and Associated Health Risk

B. A. Begum, M, A. Shahriar*, N. Hossain, I. K. Shovon, A. Hossain and Y. N. Jolly

Aquatic ecosystems, including fish and prawn species of the river, are contaminated by various trace and toxic metals. In this study, We examined the concentrations of 10 trace metals (Cr, Fe, Zn, Mn, Co, Ni, Cu, As, Hg and Pb) in 20 different fish and prawn species (n = 41) which are commonly found in the Dhaleshwari River using energy-dispersive X-ray fluorescence (EDXRF) method. The potential human health risks (noncarcinogenic and carcinogenic) of the trace metals were calculated by using Target Hazard Quotient (THQ), Hazard Index (HI), and Target Cancer Risk (TR) indices. The mean concentration (mg/kg; ww) of the trace metals in analyzed riverine fish and prawn species was in the order of Fe > Zn > Cu > Cr > Mn > Co > Hg > Ni > Pb > As. The target hazard quotient (THQ) values were less than 1 (no detrimental health effects) for all the specific metals in most of the species except M. bleekeri (1.61), G. guiris (1.29), Coricasoborna (1.28) for Cr, and Macrobrachiummalcolmsonii (1.19) for Hg indicate that the noncarcinogenic health risk to humans by consuming those species was relatively low. Based on the present study, it is imperative to take an urgent initiative to control or prevent the trace metals contamination in the Dhaleshwari River and minimize the human health risks associated with the consumption of fish and prawn species in this river in Bangladesh.

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1.21 Heavy Metals in Fish and Shell Fishes Collected from The Major Watercourse of The Chittagong Region, Bangladesh and Their Average Daily Intake

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Current study was undertaken to investigate the toxic metal concentration in the pre-selected fish and shell fishes of major watercourse of the Chittagong region (Karnafuli River Estuary) and the measurement of

average daily intake of heavy metal through fish fillet ingestion.The concentration of heavy metals namely Cr, Mn, Cu, Zn, As, Pb, Co, Ni, Fe, Br, Rb, K, Ca, V, As, Ni were quantified in 10 fish samples using X-ray Fluorescence (XRF) technique at Bangladesh Atomic Energy Commission. From this study, iron (Fe) was found in high amount in fish samples and the sample *Taenioidescirratus* (65.88 mg/kg) have the highest value. On the other hand, low amount of Ni and K among those elements were found in the studied fish samples. Heavy metal concentration in the fish samples were found in sequence of Fe>Zn>Br>Mn>Rb>V>Cu>Pb>Cr>Co>Ca>As >K>Ni respectively. The estimated daily intakes (*EDI*) of the studied metals from consumption of fish are also calculated. The mean values of *EDI* for the fish samples were found to be the following descending order of Fe>Zn>Br>Mn>Rb>Cu>Pb>V>Cr>Co>Ca>K respectively. It was found that the *EDI* values for the examined fish samples were below than that of the recommended values.

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1.22 Metals Bioaccumulation in 15 Commonly Consumed Fishes from the Lower Meghna River and Adjacent Areas of Bangladesh and Associated Human Health Hazards

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The lower Meghna River, the easternmost part of the Ganges Delta, faces severe anthropogenic perturbations as it receives a huge discharge and industrial effluents. To measure the metal concentrations and human health hazards, edible tissues of 15 commercially important fish species were collected from the local fish markets and the lower Meghna River, Bangladesh.Trace and heavy metals such as Pb, Cr, Cu, Zn, Mn, Fe, Hg, Ni, Ca, Co, Se, Rb, Sr, and As were detected using the Energy Dispersive X-ray Fluorescence (EDXRF) method. The hierarchy of mean metal concentrations obtained was: Fe (162.198 mg/kg)>Zn (113.326 mg/kg)>Ca (87.828 mg/kg)>Sr (75.139 mg/kg)>Cu (36.438 mg/kg)>Se (9.087 mg/kg)>Cr (7.336 mg/kg)>Mn (6.637 mg/kg)>Co (3.474 mg/kg)>Rb (1.912 mg/kg)>Hg (1.657 mg/kg)>Ni (1.467 mg/kg)>Pb (0.521 mg/kg)>As (BDL). Based on the metal concentration obtained, the carnivorous species contained more metals than omnivores and herbivores. Both the Targeted Hazard Quotient (THQ) and Hazard Index (HI) values for adult and child consumers were <1, indicating that consumers would not experience the non-carcinogenic health effects. The correlation, principal component analysis (PCA), and cluster analysis were conducted to identify the sources of metals identified from the fish tissue. The fishes of the area, in general, are safe for human consumption.

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1.23 Ecological and Human Health Risk Assessment of Heavy Metals in Cultured Shrimp and Aquaculture Sludge

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Shrimp is one of the major export products in South Asian countries and also an eminent source of nutrition for humans. Hence, any negative effect of this industry may affect not only the country's economy but also human health. Therefore, in this study, we aimed to assess heavy metal contamination and associated human health risks in cultured shrimp (Penaeus monodon) and aquaculture sludge collected from three shrimp farms of the Cox's Bazar district, Bangladesh.The results showed that among the eight metals studied, Pb (17.75 ± 1.5 mg/kg) and Cu (9.43 ± 2.8 mg/kg) levels in all shrimp samples were higher than the recommended limit, whereas the concentrations of Cd (0.09 ± 0.03 mg/kg), Mn (4.83 ± 2.2 mg/kg), As (0.04 ± 0.02 mg/kg), Hg (0.02 ± 0.006 mg/kg), Zn (18.89 ± 2.9 mg/kg) and Cr (0.69 ± 0.6 mg/kg) were within the permissible level. The concentrations of Mn (1043.37 ± 59.8 mg/kg), Cr (30.38 ± 2.1 mg/kg), Zn (74.72 ± 1.13 mg/kg) and Cu (31.14 ± 1.4 mg/kg) in the sludge of all farms were higher than the recommended limit, whereas the concentrations of Pb (20.23 ± 1.9 mg/kg), Cd (0.09 ± 0.2 mg/kg), As (0.44 ± 0.34 mg/kg) and Hg (0.08 ± 0.02 mg/kg) in all sludge samples were lower than the threshold limits. However, the estimated daily intake (EDI), targeted hazard quotient (THQ) and hazard index (HI) assessed for potential human health risk implications suggested that Pb and Cr may pose non-carcinogenic health effects, although carcinogenic risks (CR) values were acceptable for consumers. However, the pollution load index (PLI) of the studied area was below 1, which indicates low deterioration of the area. Geoaccumulation index (Igeo) and contamination factor (CF)

analyses revealed that study area is unpolluted and sludge is enriched with metals in the following order: Mn>Zn>Cu>Cr>Cd>Hg>Pb>As.

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1.24 Comparison of Heavy Metals Accumulation in Wild and Farmed Seabass and its Estimated Human Health Risks

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The increasinganthropogenic activities are causing severe heavy metal contamination in both natural water bodies and aquaculture systems globally, posing health risks to humans. In this study, the metal concentration (Pb, Cd, Cr, As, Mn, Cu, Zn) in different organs (gill, liver and muscle) of farmed and wild Seabass (*Lates calcarifer*) fish were examined from tropical coastal areas to asses and compare the contamination levels and associated human health risk.Samples of wild sea bass were collected from the Char Alekjander region in the heart of the Meghna River. And the cultured seabass samples were fetched from the fish market in the Noakhali district. A Varian AA240 atomic absorption spectrometer (AAS) with Zeeman background correction system equipped with a graphite fur-nace (GTA 120) was used to measure Cu, Zn, Fe, Mn, Ni, Pb, and Cd in the samples.The differences in heavy metal accumulation observed between cultured and wild fish were probably related to the differences in their environmental conditions and dietary element concentrations. Pb concentrations exceeded the national and international threshold limits, whereas concentrations of other metals were within the limit. Among the examined organs, muscle had the lowest concentration compared to others, and liver was the target organ for Pb, Cu, and Cd accumulations. Metals like Zn and Mn exhibited higher concentration in the gills. However, all the studied heavy metals were below the maximum permissible limits of national and international standards, but the mean concentrations of Pb and Cd values in the liver of cultured seabass exceeded all international and national guidelines. Based on the contamination factors (CF) and pollution indices (PLI and MPI), the degree of contamination in the fish organs was as follows: gill>liver>muscle. The major accumulation tissues for both cultured and wild fish were found to be the gill (MPI=0.970) and the liver (MPI=0.692). Based on the estimated daily intake (EDI), the fish samples examined in this study are safe for human consumption as within the recommended daily dietary allowance range established by various authorities. According to the THQ and CR calculations, though the seabass fishes depicted no potential hazard to humans, farmed fish posed a higher health risk than wild fish.

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1.25 Health Risk Assessment for Heavy Metal Accumulation in Leafy Vegetables Grown on Tannery Effluent Contaminated Soil

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Tanneries have been recognized as a possible source of producing heavy metal load to the environment even though having a significant contribution to the economic development and employment in many countries.The ultimate fate of these metals is to deposit into the soil and water, might get transferred to different plant tissues (stem, root, leaf, etc.).Consumption of metal contaminated vegetables can cause a negative impact in the food chain and may extend a negative influence on human health. Accumulation of metals (Cr, Zn, Ni, Cd, and Cu) in leafy vegetables cultivated on tannery effluent contaminated soil and agricultural land soil were determined with an Atomic Absorption Spectrophotometer (AAS). The values of risk factors for the human population were studied, where metals were transferred from tannery effluent to plants via effluent contaminated soil and finally, transmitted to human body through the consumption of these metal accumulated leafy vegetables. Leafy vegetables, namely Stem amaranths (Amaranthus lividus), Spinach (Spinacia oleracea), Red amaranths (Amaranthus gangeticus), Jute mallows (Corchorus capsularis), Water spinach (Ipomoea aquatica), and Malabar spinach (Basella alba) were cultivated on the soils collected from downstream of Hazaribagh tannery area and Keraniganj agricultural land. The study revealed that the metal contents in contaminated soil exceeded the permissible limits recommended by WHO/DoE. Tannery effluent contaminated soil was found more polluted than the agricultural land soil. Metal contents in leafy vegetables cultivated on contaminated soil were higher than that of agricultural soil and exceeded the permissible limit, particularly in the case of Cr (125.50–168.99 mg/kg Dw) and Cd (0.19–0.83 mg/kg Dw). Metal content order

was found as Cr>Zn>Ni>Cu>Cd for contaminated soil and Zn>Cr>Cu>Ni>Cd for agricultural land soil. The metal accumulation and translocation were found in vegetables in the order of Spinach>Water spinach>Malabar spinach>Jute mallows>Red amaranths>Stem amaranths. The analyses also revealed that the metal translocation rate in the plants of contaminated soil was higher than that of non-contaminated agricultural soil. The values of each risk index exceeded 1 in case of vegetables cultivated in contaminated soil. Therefore, the possible threat of chronic and carcinogenic diseases emerged if those polluted vegetables would be consuming as daily diet.

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1.26 Microplastic Contamination in Food Grade Sea Salt in Bangladesh

T. R. Choudhury, A. Nur* and M. B. Hossain*

The ubiquity of microplastics (MPs) in aquatic environments and their ecological impacts have caused widespread concern. However, knowledge about the exposure of MPs in the marine environment of Bangladesh is limited. To address this issue the present study was designed to investigate the occurrence and characteristics of MPs in five different commercial brands of table salt and unprocessed salt from 15 salt pans at Cox's Bazar, Bangladesh.The abundance of MPs in the commercial salts ranged from from 111.67 ± 24.66 to 195.00 ± 25.00 items/kg which were lower than the MPs identified in the salt samples from salt pans (141.67 ± 15.28 to 290.00 ± 27.84 items/kg). Analyses of variance (ANOVA) showed a significant ($p< 0.01$) difference among the mean abundance of MPs in both commercial salts and salt from salt pans. Most of the identified MPs were fibers and transparent in both commercial processed and unprocessed salt from salt pans. The predominant MPs were found to be < 0.5 mm in size in both cases. Domestic and municipal wastewater flow to Bay of Bengal and fishing activities may attribute to MPs in the salt from salt pans. Some of these MPs can be removed through refining process, but cannot be removed fully. However, the presence of MPs in sea salt indicates the anthropogenic impact on the gradual accumulation of MPs in oceans. As plastics absorb the persistent organic pollutants and enter to the food web, MPs may pose threat to food safety. Therefore, the periodic monitoring and characterization of MPs in sea salts would be mandatory for human welfare.

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1.27 The Concentration, Source Identification and Potential Human Health Risk of Heavy Metals in Poultry Feed, Meat and Eggs in Bangladesh

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The aim of this study was to determine the levels of heavy metals inpoultry feed, chicken meat, chicken egg and to assess the risk of carcinogenic and non-carcinogenic effects caused by the consumption of chicken products along with the identification of possible sources of these heavy metals.Chicken meat, egg and feed were collected from selected broiler farms in Hemayetpur, Savar.The levels of Pb, Cd, Cr, As, Ni, Mn, Cu, and Zn were assessed in chicken meat, chicken eggs, and poultry feed samples using AAS. In addition, an assessment of a potential threat to human health was conducted using EDI, THQ, TTHQ, and CR data. All metal concentrations were determined to be below the maximum allowed concentration (MAC) with the exception of lead, nickel, and copper in chicken meat and lead, cadmium, nickel, and copper in chicken eggs. The CRs of lead, cadmium, and arsenic were all well within safe ranges; however, the CR of chromium was noticeably higher. As a result, the possible health risk that was given to consumers by elemental exposure through the intake of chicken meat and chicken eggs should not be ignored. The heavy metal contents in polutry feed of all the tested samples were found high relevant from a toxicological point of view. As a consequence of this, it is advised that continuous monitoring of chicken meat and chicken egg products should be carried out in order to assess a possible harm to the health of consumers.

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1.28 Phytosterols in Rice Bran Oil and Mastered Oil Consumed by Bangladeshi People: A Comparative Study

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

Rice bran oil and Mastered oil are phytosterol enrich edible oils. Phytosterols are important micronutrients in the human diet. Phytosterol (plant sterols and stanols) exist as naturally occurring plant sterols that are

present in the non-saponifiable fraction of plant oils. Phytosterols plays a vital role in lowering blood cholesterol and therefore reducing cardiovascular disease. The target of our analysis is to access that which one is better than these two edible oils. In this study, we have analyzed eleven oil samples with two classes – mastered oil and rice bran oil. Five of them rice bran oil and six of them were mastered oil. Gas Chromatography-Mass Spectroscopy (GC-MS) technique was applied for the investigation of Phytosterols compounds in Rice Bran Oil and Mastered oil. Five Major Phytosterol namely Ergost--5-en-3-ol, acetate, (3β,24R), β-sitosterol acetate, compesterol, stigmasterol, and sitosterol were found in investigated RBOs and MOs. The maximum value of five phytosterols, Sigmasterol (10.52%), Sitosterol (39.46%), Campesterol (10.21%), β-Sitosterol acetate (30.73%), Ergost--5-en-3-ol, acetate, (3β,24R)- (16.21%) were found in rice bran oil. On the other hand, the maximum value of five phytosterols, Stigmasterol (10.52%), Sitosterol (33.91%), compesterol (19.07%), β-Sitosterol acetate (15.88%), and Ergost--5-en-3-ol, acetate, (3β,24R)- (7.96%) in mastered oil. According to the study we can say that rice bran oil is rich with phytosterol than mastered oil.

1.29 Bioactive Compounds of Rice Bran Oil (RBO) in Different Brands of Bangladesh: A Comparative Study

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

Rice bran oil (RBO) is the oil extracted from the hard-outer brown layer of rice grain.RBO is promoted for its high nutritional value due to the high concentrations of health beneficial bioactive compounds naturally present in the oil. Our study goal is to analysis the enrichment of different bio-active compounds and comparison of their abundance in different branded rice bran oils. Different banded five RBO samples (WG-RBO, ACI_RBO, S_RBO, F_RBO and P_RBO) were collected from different local market and preserved at 4^0C in refrigerator. 5g of RBO sample added in 100mL 2M methanolic KOH solution for hydrolyzation and then refluxed in a water bath at 45^oC for 2 hrs. The resulting mixture were centrifuged for 15 mins at 300rpm. Liquid-liquid extraction of the mixture was done after filtration. Extracted samples were evaporated slowly using an evaporator separately. Then the samples were pre-concentrated to 1-2 mL by using nitrogen gas. Gas Chromatography-Mass Spectroscopy (GC-MS) technique was applied for the investigation of bioactive compounds in Rice Bran Oils (RBO). A significant deviation has been found because the percentage of rice bran oil compounds varies from brand to brand. 18, 12,16, 9, 13 number of compounds were identified in investigated samples namely WG-RBO, ACI_RBO, S_RBO, F_RBO and P_RBO respectively. The percentage of abundance of Gamma Sitosterol is 24.49% in WG-RBO, 22.82%in ACI-RBO, 16.72% in S-RBO, 39.46% in F-RBO and 7.45% in P-RBO. Stigmasterols is 10.52% in WG-RBO, 4.80% in ACI-RBO, 2.83% in S-RBO, 8.23% in F-RBO and 1.84% in P-RBO. 9-Octadecenoid acid (Z)-,2-hydroxy-1-(hydroxyethyl) ethyl ester is 4.63% in WG-RBO, 2.83% in S-RBO, and 54.98% in P-RBO. Ergost-5-en-3-ol, acetate, (3β,24R) -, is 7.96% in WG-RBO, 15.83%in ACI-RBO, 16.21% in S-RBO, 8.01% in F-RBO and 7.35% in P-RBO. Campesterol is 7.12% in WG-RBO, 3.13% in S-RBO, 10.12% in F-RBO and 2.57% in P-RBO (VI) Stigmast-5,22-dien-3-ol, acetate, (3β,22Z)- is 2.97% in ACI, in 1.69% S-RBO in20.56%. Dibutyl-phthalate is 3.80% in ACI-RBO, 4.19% in S-RBO, 2.14% and F-RBO 7.45% in P-RBO respectively. It can be concluding that WG-RBO is the most suitable brand of rice bran oil for uses in perspective of enrichment of bioactive phytosterol among all the other brands.

1.30 Investigation of Some Essential Organic Compounds in Masterd Oil in Different Manufacturer Brands, Bangladesh

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

Mustard oil is extracted from the seeds of the mustard plant, which is an ingredient cuisine. It commonly known for its flavor, pungent aroma and high smoke point. It provides essential fatty acids, antioxidant and a variety of other nutrients. It decreases HDL thus decrease blood pressure, inflammation and can improve vascular function and reduce the risk of cardiovascular disease. Popularly it is used in cooking but it also serves the purpose of salad oil, hair oil, face and body oil, baby massage oil. Analysis the enrichment of different bio-active compounds and comparison of their abundance in different mastered oil is our study target.Masterd oil is a rich source of essential fatty acids, antioxidant and a variety of other nutrients. Using masterd oil have several health benefits. Different banded six MO (T-MO, Ra-MO, S-MO, F-MO, L-MO and P-MO) samples were collected from different market- places for the analysis of essential organic compounds. 5g of each oil samples were taken into a conical flux, then added 100mL of 2M methanolic KOH solution for

hydrolyzation. Hydrolyzed sample were refluxed in a water bath at 45^{o}C for 2 hrs. Refluxed mixture was centrifuged for 15 mins at 300rpm. Liquid-liquid extraction processwere applied. Extracted samples were evaporated slowly using an evaporator separately and then the samples were pre-concentrated to 1-2 mL by using nitrogen gas. Gas Chromatography-Mass Spectrometry (GC-MS) technique was applied for the investigation of bioactive compounds in Masterd oil. 3, 7,8, 14, 9 and 18 numbers of organic compounds were identified from T-MO, Ra-MO, S-MO, F-MO, L-MO and P-MO respectively.The percentage of abundance of β-Sitosterol is 33.91% in Ra-MO, 23.29% in S-MO,28.02% in F-MO,8.56% in L-MO and 24.49% in P-MO. Campesterol is 19.07% in Ra-MO, 15.13% in F-MO,7.12% in P-MO. 1-Butene, 4-isothoicyanto is 33.91% in T-MO,4.22% in Ra-MO, 44.95% in S-MO,19.46% in F-MO, and 7.91% in L-MO. 5-Cholestene -3-ol,24-methyl-is,55.87% in T-MO, and 8.77% in S-MO. Ergosta -5,22-dien-3-ol, (3β,22E,24S) is 11.25% in Ra-MO, 11.96% in S-MO, and 15.68% in F-MO. Stigmasterol is 10.52% in P-RBO respectively. It can be concluding that F-MO is the most suitable brand of mastered oil for uses in perspective of enrichment of bioactive phytosterol among all the other brands.

Atmospheric and Environmental Chemistry

1.31 Collection of Baseline Data of Chemical Concentration of Various Components of Rooppur Nuclear Power Plant Construction Area

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Nuclear power is a wonder of modern day and widely held as a safe and reliable source of energy. Bangladesh has started its journey as a member of nuclear power club through the construction of a nuclear power plant (NPP) at Rooppur, Pabna. After construction, NPP has the potential to influence the ambience of its surroundings. Hence, although best precautions are being taken leaving no chance for any such occurrence, it is essential to have pre-construction data of the ambience of the NPP to be used as a baseline data. The current project has been undertaken to find out chemical concentration of various components of the environment including water, soil, sediment, food etc. collected from the NPP area to form a baseline data for future purpose. A roadmap has been made for year around sample collection from the area of 30 Km radius around the Rooppur nuclear power plant (RNPP), their processing, preparation and analysis in the laboratory and reporting to the stakeholders. As per the roadmap, sample collection has begun from Feb. 2021 for winter season. 167 samples (excluding surface water for gross analysis) including water, soil, sediment, vegetables, fish, beef, cow milk, grass etc. was collected. Consequently 152 samples (excluding surface water for gross analysis) in Rainy season of (Aug.) 2021 and 158 samples (excluding surface water for gross analysis) in the winter season of (Feb.) 2022 were collected. All of the samples have already been analyzed and the report of analysis of has been delivered to the stakeholders. They were tested for various target analytes. Physiochemical parameters were measured using various meters e.g. pH meter, portable multimeter etc. as sell as manual titration technique. Heavy metals including Pb, Cd, Cr, As, Hg, Ni, Cu, Zn, Fe, Mn, Ni, Co etc were analyzed using flame, graphite furnace, cold vapor, hydride generation etc. mode of atomic absorption spectroscopy (AAS). Ions including F, Cl, Br, NO_3^{2-}, SO_4^{2-}, Br^-, NO_3^-, PO_4^{3-}& Li, Na, K, NH_4^+, Ca^{2+}, Mg^{2+} has been analyzed using ion chromatography. Metals in some samples e.g. soil, feed etc were analyzed using x-ray fluorescence (XRF). As per rough estimation, seasonwise around 3000 and annually 9000 test analysis has been performed. Summary of RNPP samples analysis are as follows

Matrix	Responsible lab	Technique	Parameter	No of test	No of sample	Total
Drinking Water	ACL	AAS	Pb, Cd, Cr , Cu, Ni ,Co, Fe, Mn, Zn, As, Hg	11	5	55
	Main Lab	IC	F, Cl, Br, NO_3^{2-}, SO_4^{2-}, Br^-, NO_3^-, PO_4^{3-}& Li, Na, K, NH_4^+, Ca^{2+}, Mg^{2+}	14		70
Surface Water (Gross contents)	ACL	AAS	Pb, Cd, Cr , Cu, Ni ,Co, Fe, Mn, Zn, As	10	44	440
	Main Lab	IC	F F, Cl, Br, NO_3^{2-}, SO_4^{2-}, Br^-, NO_3^-, PO_4^{3-}& Li, Na, K, NH_4^+, Ca^{2+}, Mg^{2+}	14		616

Matrix	Responsible lab	Technique	Parameter	No of test	No of sample	Total
Surface Water (soluble)	ACL	AAS	Pb, Cd, Cr, Cu, Ni, Co ,Fe, Mn, Zn, As, Hg	11	44	484
Vegetation	ACL	AAS	As & Hg	2	24	48
	ACL	AAS	Cr, Mn, Fe, Co, Ni, Cu, Zn, Cd, Pb	9		216
Aquatic Vegetation	ACL	AAS	Pb, Cd, Cr , Cu, Ni ,Co, Fe, Mn& Zn	9	15	135
Soil	ACL	AAS	Cd & Hg	2	12	24
	AECL	XRF	PH, EC, Salinity, TDS and K, Ca, V, Cr, Mn, Fe, Co, Ni, Cu, Zn, As, Se, Rb, Sr, Y, Zr, Mo, Pb	22		264
Sediment	ACL	AAS	Cd	1	18	18
	AECL	Meters/XRF	PH, EC, Salinity, TDS and Fe, Mn, Cr, Ni, Co, Cu, Zn, As, Pb	13		234
Milk	ACL	AAS	Pb, Cd, Cr , Cu, Ni ,Co, Fe, Mn, Zn, As & Hg	11	5	55
Meat	ACL	AAS	Pb, Cd, Cr , Cu, Ni ,Co, Fe, Mn, Zn, As & Hg	11	5	55
Fish	ACL	AAS	Pb, Cd, Cr , Cu, Ni ,Co, Fe, Mn, Zn, As & Hg	11	5	55
Grass	ACL	AAS	As & Hg	2	12	24
	ACL	AAS	Cr, Mn, Fe, Co, Ni, Cu, Zn, Cd, Pb	9		108
Feed	ACL	AAS	Hg	1	15	15
	AECL	XRF	Cr, Mn, Fe, Co, Ni, Cu, Zn, As, Se, Sr, Pb	11		165
Seasonwise subtotal (approximate)					204	3081
Number of season per annum (may vary with provided supports)					3	
Total analysis per annum (approximate)					612	9243
Note- Only the inorganic analysis has been included. Including organic analyses will raise values. This is an approximation. Exact numbers may vary slightly with the change in number of samples.						

1.32 The Vulnerability of Coastal Landscapes and Ecosystems to Sea-Level Rise and Climate Change

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

To assess the vulnerability of the coastal landscape and ecosystem due to sea level rise that is being caused by climate change. The aim of the project is to assess the rate of sea level rise with climate change and possible impact on the shoreline ecosystem.Sediment core along with water and leaves from different point of Sundarban has been collected. The sediment cores has been carefully sliced, separated and dried. One portion of the dried sediment has been sent to IAEA affiliated laboratory at Australia for relevant analysis while the rest are being checked for organic content. Later, it will be tested for the presence of heavy metals. The water has been tested for various physiochemical parameters and waiting to be tested for the presence of the heavy metals. The leaves have been dried and also waiting for metal analysis.

*International Atomic Energy Agency (IAEA)

1.33 A Study on Determination of Heavy Metal (Pb, Cd, Hg, Cr, Cu, Zn, Mn, Fe and As) in Aquaculture (Soft Shell Crab, Life Crab, Shrimp and Prawn) Farm at Shyamnager, Satkhiradistrict

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

Crab/shrimp/prawn are important food item that has a high potential as known item in the local market as well as a popular item in the international market. Their cultivation through farming is quite popular in Satkhira and has a reputation to dominate this industry in the market. However, with the of the looming threats of heavy metals in our food items, it is important to check the possibility of the presence of common heavy metals in these foods with high economic importance.Under this project, collection of crab/shrimp/prawn along with the components of their habitat like leaf and root of the trees has been done partially. The collected samples has already been analysed for the presence of Pb, Cd, Cr, As, Hg, Ni, Cu and Zn.

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1.34 Heavy Metal Accumulation of Soft Shell Crab Cultivation in Different Paramenters (Water and Sediment)

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

Crab/shrimp/prawn are important food item that has a high potential as known item in the local market as well as a popular item in the international market. Their cultivation through farming is quite popular in Satkhira and has a reputation to dominate this industry in the market. However, with the of the looming threats of heavy metals in our food items, it is important to check the possibility of the presence of common heavy metals in these foods as well as in the different parameters of their ambience like water and soil.Under this project, collection of water and soil from nearby areas of the cultivating farms has been performed. Some of the collected samples has already been analysed for the presence of Pb, Cd, Cr, As, Hg, Ni, Cu and Zn.

*Department of Zoology, Jagannath University

1.35 Heavy Metal Contamination in The Water Across The Passurriver of The Sundarbans Mangrove Forest

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

Sundarban is the worls largest naturally grown mangrove forst. It has a unique environment supporting and harboring a huge number of animals and plants including endangered ones. With the aggression of heavy metal contamination commonly through water way and having the Passur river running through the forst, it is important to check the different components of the river system. Thus, this work was aimed to check the level of heavy metals curruently present in water of the river at different points within the forest.The project is at its early stage. So far, water samples have been collected from 6 stations and they have been prepared for analysis. Target analytes include Pb, Cd, Cr, As, Hg, Ni, Cu, Zn etc.

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1.36 Assessment of The Vulnerability of Mangrove Ecosystem of The Sundarabans Mangrove Forest to Metallic Contamination

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

Sundarban is the worls largest naturally grown mangrove forst. It has a unique environment supporting and harboring a huge number of animals and plants including endangered ones. With the aggression of heavy metal contamination commonly through water way and having the Passur river running through the forst, it is important to check the different components of the river system. Thus, this work was aimed to check the level of heavy metals curruently present in trees of nearby the river at different points within the forest.The project is at its early stage. So far, leaves and root samples has been collected from 6 stations and they are yet to be prepared for analysis. Target analytes include Pb, Cd, Cr, As, Hg, Ni, Cu, Zn etc.

*Department of Environmental Science, Khulna University

1.37 Evaluation of The Metallic Contamination of Sediments of The Passur River of The Sundarbans Mangrove Forest

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

Sundarban is the worls largest naturally grown mangrove forst. It has a unique environment supporting and harboring a huge number of animals and plants including endangered ones. With the aggression of heavy metal contamination commonly through water way and having the Passur river running through the forst, it is important to check the different components of the river system. Thus, this work was aimed to check the level of heavy metals curruently present in sediment of the river at different points within the forest.The project is at its early stage. So far, sediment samples has been collected from 6 stations and they are yet to be prepared for analysis. Target analytes include Pb, Cd, Cr, As, Hg, Ni, Cu, Zn etc.

*Department of Environmental Science, Khulna University

1.38 Trace Metals Concentration, Quality Indices, Pollution Sources, Bio-accumulation and Health Risk Assessment: Water and Fish from Kaptai Lake, Rangamati

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

To assess the pollution source and human risk assessment of water and fish from Kaptai lake, Rangamati.The concentration of selected trace metals Pb, Cd, Cr, Hg, Cu, Ni, Mn , Zn in collected surface water samples and Al, Fe, Mn, As, Cr, Pb, Cd, Hg, Co, Cu, Ni, Mo, Se, Ag, Zn, Sb, U, Sn in collected fish samples of five different indigenous species was measured. The mean trace metals concentration in water and fish was below maximum permission limit. All the physicochemical parameters except DO, COD in water were within permission limit. Water quality indices include water quality index (WQI), heavy metal pollution index (HPI) and heavy metal evaluation index (HEI). WQI indicates 80% of the water samples fall in poor water quality for drinking. However HPI ranked 47%, 23%, 30% of water samples as low, medium and high pollution respectively. According to HEI all the water samples fall in low pollution category. The hazard index (HI) shows no non-carcinogenic health risk for dermal contact of lake water for both adult and child but 10% water samples show medium non-carcinogenic health risk for child through ingestion. The life time cancer risk (LTCR) value shows 9.05% and 33.33% water samples have carcinogenic effect towards adult and child respectively.

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1.39 Soil Properties and Pollution Indices in Four Designated Wetlands in The Sylhet Basin of Bangladesh

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

Present research has been carried on 16 sites in four Ramsar designated wetlands soils regarding soil properties and pollution indices in the Sylhet basin of Bangladesh. As and Cd were found at minimum detection levels of the analytical system. Rb and Zr were found below critical levels. Pollution indices revealed that zinc and titanium content is slightly higher than the other elements. Fe, Ti, Zr, and Mn originate from natural sources, while Zn and Cu originate from anthropogenic sources like the artificial fertilizer sources. Pollution load index stipulated 42% of the study sites were polluted and 58% remained unpolluted. Principal component analysis and enrichment factors show that anthropogenic activities are responsible for the current pollution, where Zn and Cu predominate. The overall wetland sites are being polluted at a minor level. The main reasons for the higher level of metal pollution in Balai wetland might be its geomorphic nature and even anthropogenic activities.

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1.40 Heavy Metals Pollution in River Sediments, Water and Some Edible Fishes Around Dhaka in Bangladesh and Associated Human Health Risk Assessment

Y. N. Jolly, S. Akter, J. Kabir, K. M. Mamun and A. F. Ruma*

River sediment and water samples were collected in two distinct seasons to determine particle size, moisture content, pH, EC, OC and total NPK for the sediment samples, and pH, EC, turbidity, TDS, chloride, total hardness, and dissolved oxygen for the water samples following standard methods. Due to their wide range of

distribution, river fish have been widely used as bioindicators to assess and monitor heavy metal concentrations in the river ecosystem as such fish samples were also vcollected. Energy Dispersive X-ray Fluorescence (EDXRF) Spectrometer was used as the major analytical technique for carrying out heavy metal analysis, viz., Chromium, Manganese, Iron, Copper, Zinc, Arsenic, Selenium, Mercury and Lead in fish samples and Cr, Ni, Cu, As and Pb in sediment and water samples respectively. The average values of pH, EC (µS/cm), OC (%), OM (%), Total N (%), Total P (%), Total K (%) in the sediment sample were 7.05±0.50, 33.70±11.90, 2.15±0.76, 3.69±1.30, 0.16±0.04, 0.34±0.06 and 0.16±0.03, respectively. The average concentration of heavy metals in sediments was found in the decreasing order of Pb>Cu>Cr>Ni>As>Cd. Significant difference was found among the seasonal values of water properties at a confidence interval of 95% and the p value for the significant contrast. Health risk assessment identified that children are more exposed to heavy metals than adults and both the population groups are in vulnerable situations considering non-carcinogenic and carcinogenic health risks through the consumption of the studied fishes.

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1.41 Evaluation of Hazardous Effect of Heavy Metals from a Point Source Wastewater on Fish (Anabas cobojius H.) and Human Health

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

Present study was sketched to determine physical (electrical conductivity, turbidity and temperature) and chemical (pH, dissolved oxygen, total dissolved solids and salinity) properties of the point-source industrial wastewater at varying concentration andtheir effects on fish mortality by culturing a native fish in varying concentration of wastewater in different exposure period and to assess the probabilistic human health risk by the bioaccumulation of heavy metals in cultured fish species via dietary intake.Results revealed that water quality parameters declined with the increase of wastewater concentration and Trace metal evaluation index (TEI) stipulated a high level of water pollution due to Cr, Mn, Fe, Co, Ni, Cu, Zn, As content for all percentage of waste water. Concentration of wastewater and duration of culture treatment time largely impacted on fish mortality rate, body dis-pigmentation, mucus secretion rate, coagulation of mucus all over the body and accumulation of heavy metals by fish. However estimated MPI indicated low contamination of fishes by the measured toxic elements. Zn and Hg contribute significantly on non-carcinogenic health implications for both the population group. Nevertheless Hazard Index (HI) manifested very high to medium significant health effect regardless of age. However carcinogen Pb showed insignificant risk but Cr and Ni showed extremely high to medium-high carcinogenic risk for both adults and children and hence children were found more vulnerable receptor than adults regarding to HI and CR value. Multivariate statistical analysis revealed that heavy metals are mostly coming from anthropogenic sources

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1.42 Impact of Solid Waste with Special Emphasis on Heavy Metals on Surrounding Environment of Amin Bazar Landfill Site

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

Three different locations such as abandoned landfill, dumping and its surrounded agricultural areas of Amin Bazar landfill were selected for soil and plant samples; leachate samples from active dumping area and sediments from untreated and treated leachate pond from which nutrients and metals were analyzed. Concentration of Cu, Ni and Zn exceeded the permissible limit and found in the order of Zn > Pb > Cr > Cu > Ni of dumping areas and sediments from untreated and treated leachate pond. Cluster analysis of the elements showed that the decomposed area was more contaminated than abandoned and surrounding agricultural areas. The heavy metal concentrations in plant samples did not show any significant contamination except Cu, Ni and Zn that exceeded the permissible limit. In contrast, the organic matter and nutrient concentrations such as N, P, K and S of both soil and plant samples showed desirable value in this studied area. The value of DO, BOD, COD, TDS and EC of the untreated leachate were found 0.60 mgL^{-1}, 81.66mgL^{-1}, 942.33 mgL^{-1}, 7809 mgL^{-1} and 15655 μScm^{-1} respectively that exceeded inland surface water standard but after treatment the concentrations of DO, BOD and TDS in the treated leachate pond were found within the permissible limit. The concentration of sediment sample from untreated and treated leachate pond showed higher value of Cr, Cu, Ni, Pb and Zn that exceeded the permissible limit according to WHO.

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

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

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

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1.44 Quantification of Heavy Metal Level in Plants and Soils Collected from Agricultural Land Beside Turag River

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

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

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1.45 Heavy Metal Concentrations in Coastal Sediments and Water Around Shitakundo Ship Dismantling Industrial Areas of Bangladesh

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

Shitakundo is one of the main coastal areas alongside the Bay of Bengal in Bangladesh that has been experiencing severe pollution from ship breaking industries. The main purpose of this research is to find out the sources, concentrations, and transformation of metals (loid) from coastal ecosystem including inland water as well as obtaining the exposure scenario and carcinogenic and non-carcinogenic risks of heavy metals coming from the locality of ship recycling industry which may affect adversely in human health and environment of the entire area**.** A total of 40 sediment samples from the upper littoral (yard area) and lower littoral (saturated sediment) of the ship beaching area was collected from the study area. Water samples was collected from the offshore of the northern Bay of Bengal where ship breaking industries are densely located along with inland water samples that carries most of the debris of ship dismantling areas. For sediment samples, Energy Dispersive X-ray Fluorescence (EDXRF) Spectrometer was used as a major analytical technique for determining elemental concentration, controlled by a software package provided with the system. Heavy metals concentration in water was determined by using Atomic Absorption Spectrophotometer (AAS). The physicochemical parameters of water such as pH, EC, DO, TDS, Turbidity, Alkalinity, Hardness, BOD, COD, Nitrate, and Phosphate was also determined using standard analytical technique. Concentrations of Fe, Zn, Cr, As and Pb were found higher than the admissible limit, which reflects the frequent occurrence of the harmful effect. The ecological risk index for the sediment of Shitakundo ship breaking area was calculated for Cr, Zn, Cu, As and Pb and found in the increasing order of Cr < Zn < Cu < As < Pb. Pb showed the highest ecological risk compared to other metal studied. The pollution load index (PLI) value reflects the deterioration of the sediment quality. Geo-accumulation index and Enrichment Factor index revealed that the

sediment samples of this study area were considerably polluted by the metals studied, especially by Pb, which is supported by the estimated ecological risk index value.

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1.46 Preparation and Characterization of Biochar from Bioslurry Textile Sludge and Food Sludge and Their Subsequent Effects on Soil

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

The pyrolytic conversion of sludge to biochar and biochar application to the land is a sustainable carbon management option.in this study, a comprehensive baseline assessment and preparation of biochar from Textile sludge and Food industry sludge was carried out. The pyrolysis temperatures for biochar production were set at 300˚C, 400˚C, and 500˚C, respectively. The residence time was 2 hours for each treatment with nitrogen flow. In this study, the biochar yields were decreased by increasing pyrolysis temperature. The parameters such as pH, EC, C/N ratio, TP, TK were also increased with increased pyrolysis temperature. The ATR- FTIR study confirmed that the sludges and biochar's major surface functional groups were O–H, C–H, C–O, C=O, and C=C from the identical fingerprint region. Both types of biochar produced from sludgesdid not significantly affect the germination test or early growth (root and shoot length) of Spinach (*Spinacia oleracea*), Mustard (*Brassica nigra*), and Mung bean (*Vigna radiata*) seeds. This work demonstrates that the biochar derived from textile and food industry sludge can be used as an environmentally cost-effective soil amendment.

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

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

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

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1.48 Source Determination and Seasonal Variation of PM_{10}, $PM_{2.5}$ and black Carbon and Their Chemical Composition in Semi-Residential and Industrial Area of Dhaka city

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

Particulate air pollution is the major concern in Bangladesh and thus it is necessary to under stand the characteristics of the pollutantaswellassourcesforfurther improvement oftheair quality.In thisview, particulatematter (PM) samplingwas donebetween Jan. 2019 to Feb. 2020 at two Continuous Air Monitoring Stations located at Atomic Energy Centre and Darussalam in Dhaka city.PM sampling was performed using dichotomous samplers, which collect samples in two sizes: PM2.5 and $PM_{2.5\text{-}10}$. Samples were collected on 37 mm Teflon filters. These filters were weighed for PM mass, analyzed for BC by *Smoke-stain* Reflectometer and elemental analysis by EDXRF. Data reveal that the pollution from particulate matter varies greatly with climatic conditions. It was found that the PM and BC concentrations in Darussalam were higher than Atomic Energy Centre, Dhaka. A major cause might be transboundary transport of pollutants from agricultural burning in upwind regions. Moreover, the number of brick kilns, bus terminals and industrial emissions in

Darussalam Dhaka is greater than Atomic Energy Centre area. Principal component analysis method and Positive Matrix Factorization (PMF) 5.0 was used to find out the fingerprint of different sources, which are responsible for polluting the atmospheric air.

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1.49 Ambient Concentration of Particulate Matter $PM_{2.5}$ and Black Carbon: A Comparative Study of Two Different Locations in Dhaka City

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

This study focus on the long term temporal trends of fine particulate matter and BC in Dhaka city.Air particulate samples (APM) were collected from two different locations of Dhaka city. One is semi-residential site (Atomic Energy Centre, Dhaka) and other is Darussalam site, Mirpur, Dhaka. The AECD has been collecting APM samples since 1996. In the present study, data collected between 2010-2018 were considered. On the other hand, AECD has collected APM samples from Darussalam from Feb. 2018-Dec. 2018. Using the estimates of air particulate matter, $PM_{2.5}$ made from the mass size distributions, the long –term average values of $PM_{2.5}$ and BC are estimated. The season wise shares of $PM_{2.5}$ of two sites are computed. The semi-residential (SR) (AECD) site, is located at the Atomic Energy Centre, Dhaka Campus with relatively less traffic. The Darussalam site (CAMS-3) is located at Information Centre, Mirpur with high traffic. It has found that BC at Darussalam site is 40% of total PM2.5 whereas BC value is about 30% of total $PM_{2.5}$ at SR site which are mainly of anthropogenic origin and predominately from transport related sources**.**

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1.50 Fine particulate matter and Black carbon in Dhaka City, Bangladesh: Temporal Variations, Transport Pathways and Impacts of Meteorology

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

In this research work, fine particulate matter ($PM_{2.5}$) and Black Carbon (BC) were collected from a semi residential site located at Dhaka university campus starting from Mar. 2018 to Feb. 2019. Then the mass concentrations of $PM_{2.5}$ and BC were measured. Statistical analysis shows that PM2.5 has min-5.104, max-96.391, mean-29.61, median- 26.64 and for BC it was 1.103, 14.357, 6.67, 5.787 (ugm^{-3}) respectively. The mean BC/$PM_{2.5}$ ratio was found to be 0.256. BC/$PM_{2.5}$ ratio varies from 0.01 to.70 during the study period. Then the influences of meteorological parameters such as- (temperature, relative humidity, wind speed, wind direction and rainfall) on $PM_{2.5}$ and BC mass concentrations have been studied. Temporal and Seasonal variations of $PM_{2.5}$ and BC were also studied. From the time variation analysis, it was observed that in winter both $PM_{2.5}$ and BC have high mass concentrations and it falls down gradually during the summer time. Then to understand the meteorological effects various kinds of statistical analysis were done such as- Seasonal correlation between the measured variables based on Pearson correlation method and for source identification of the pollutants Bivariate polar plots and K-means Clustering methods were used. Back trajectory clustering has been used to illustrate the transport pathways of air masses and the cluster pathways for each season were also investigated. ThePSCFandCWTmaps were used to describethepotential source areas of $PM_{2.5}$.

1.51 Analysis of Possible Transport Path and Source Distribution of Wintertime $PM_{2.5}$ and BC Pollution in Dhaka City

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

This research work investigates the possible transport path and transboundary source locations of $PM_{2.5}$ in winter season at Dhaka city. Fine particulate matter ($PM_{2.5}$) and black carbon (BC) were collected from a semi residential site located at Dhaka University campus in every winter season from Dec., 2014 to Jan., 2018 using Gant sampler. To understand the contribution of the black carbon (BC) and fine particle ($PM_{2.5}$) to the particulate matter pollution, the ratio of BC/$PM_{2.5}$ is considered. This study reveals the changes in the mass concentration of $PM_{2.5}$ and BC in these periods with respect to the change of meteorological condition (humidity, temperature, wind speed). To detect the presence of specific emission sources that enhance the pollution over receptor sites, the conditional probability function and conditional bivariate probability function techniques are employed in the present study. Concentration weighted trajectory analysis using back trajectory (by HYSPLIT-4 model) is also employed in the present study to discover the impact of transboundary pollution. Air mass trajectory analysis with HYSPLIT model showed that the long range

transport may be significantly contributed to the particulate matter concentration at that mentioned area. Hence there was a huge pollution during winter season.

1.52 Thermo-economic Feasibility Study of The First Nuclear Power Plant in Bangladesh Using Levelized Cost of Electricity and Genetic Algorithm

B. A. Begum, A. H. Khan, M. Hasan, M. M. Rahman, A. S. M. M. Hoque and M. S. Rahman

In this work, the thermo-economic feasibility of Rooppur nuclear power plant is studied. It is the first nuclear power plant being constructed in Bangladesh and expected to be operational by 2023. In order to analyze the performance parameters of this power plant in the weather condition of Bangladesh, a simplified Rankin Cycle is utilized. The unknown plant thermo-physical parameters are predicted using Genetic Algorithm-based optimization process. Results reveal that the predicted values of the plant performance parameters by the simplified thermodynamic cycle sufficiently accurate. The maximum overall efficiency and the maximum output power of each unit of Rooppur nuclear power plant are predicted to be around 35.87% and 1152.16MW_e respectively, down by 3.94% from the rated values. Also, Condenser thermal load is observed to be increased by 2.53%. The performance parameters obtained from the study are used to calculate the Levelized Cost of Electricity (LCOE) for the power plant. The predicted LCOE for the plant is 91.19$/MWh for 50 years operating life, lower than most of its conventional and renewable competitors. Finally, it is estimated that Rooppur nuclear power plant has to operate for at least 20years to remain economically feasible in context of Bangladesh.

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1.53 Association of Household Air Pollution with Cellular and Humoral Immune Responses among Women in Rural Bangladesh

B. A. Begum, R. Raqib*, E. Akhtar, T. Sultana and S. Ahmed

Household air pollution (HAP) arising from combustion of biomass fuel (BMF) is a leading cause of morbidity and mortality in low-income countries. Air pollution may stimulate pro-inflammatory responses by activating diverse immune cells and cyto/chemokine expression, thereby contributing to diseases. We aimed to study cellular immune responses among women chronically exposed to HAP through use of BMF for domestic cooking. Among 200 healthy, non-smoking women in rural Bangladesh, we assessed exposure to HAP by measuring particulate matter 2.5 ($PM_{2.5}$), black carbon (BC) and carbon monoxide (CO), through use of personal monitors RTI MicroPEM™ and Lascar CO logger respectively, for 48 h. In contrast, a doubling of CO was associated with 1.20% reduction in CD19+ B lymphocytes (95% confidence interval (CI) = -2.36, −0.01). Our findings suggest that chronic HAP exposure through BMF use adversely affects proportions of B lymphocytes, particularly memory B cells, plasma IgE levels and functions of antigen presenting cells in rural women.

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1.54 Associations Between Ambient Fine Particulate Matter and Child Respiratory Infection: The Role of Particulate Matter Source Composition in Dhaka, Bangladesh

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This stduy investigates the associations between short-term variation in ambient $PM_{2.5}$ and incidence of pneumonia and upper respiratory infections among children in Dhaka, Bangladesh **.**Air pollution in the form of fine particulate matter ($PM_{2.5}$) has been linked to adverse respiratory outcomes in children. However, the magnitude ofthis association in South Asia and sources of $PM_{2.5}$ that drive adverse health effects are largely unknown. This study evaluates associations between short-term variation in ambient $PM_{2.5}$ and incidence of pneumonia and upper respiratory infections among children in Dhaka, Bangladesh. We also perform an exploratory analysis of the $PM_{2.5}$ source composition that is most strongly associated with health endpoints. We leveraged data from health surveillance of children less than five years of age between 2005 and 2014 in Kamalapur, Bangladesh, including daily physician-confirmed diagnoses of pneumonia and upper respiratory infection. Total $PM_{2.5}$ mass was associated with a modest increase in incidence of pneumonia, with a peak effect size two days after exposure (rate ratio = 1.032; 95% confidence interval = 1.008–1.056). This study

suggests that elevated ambient $PM_{2.5}$ contributes to increased incidence of child pneumonia in urban Dhaka, and that this relationship varies among days with different source composition of $PM_{2.5}$.

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1.55 Comparative Study on the Water Quality Status of an Industrialized and a Non-industrialized Area of Bangladesh

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The adverse effect of industrialization on the water quality status is studied in this paper. Pollution level at different water sources such as tubewell, deep tubewell, pond, canal and river of Shibpur (nonindustrialized) and Sonargaon (Industrialized) area was monitored by evaluating the physico-chemical water quality parameters. These parameters include temperature, pH, TDS, COD, DO, EC, salinity and anions (F-, Cl- , Br- , NO2 - , NO3 - , SO4 2-). It was found that the average value of temperature, TDS, salinity, F - , Cl- and SO4 2- in water sources of all locations were below the permissible level of World Health Organisation (WHO) and Department of Environment (DoE), Bangladesh. However, the value of pH, DO, EC, COD, nitrate, bromide and nitrite in some locations were found higher than the permissible level. The comparative study of the water quality parameters showed that Sonargaon area was more polluted than Shibpur. It can be concluded that the higher pollution of the water in Sonargaon area is due to the release of effluent from various industrial units.

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1.56 Exposure to Household Air Pollutants and Endothelial Dysfunction in Rural Bangladesh: A Cross-Sectional Study

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More than one third of world's population use biomass fuel for cooking that has been linked to an array of adverse health hazards including cardiovascular mortality and morbidity. As part of Bangladesh Global Environmental and Occupational Health (GEO Health) project, we assessed whether household air pollution (HAP) was associated with dysfunction in microvascular circulation (measured by reactive hyperemia index [RHI]). We measured exposure to HAP (particulate matter [$PM_{2.5}$], carbon monoxide [CO], and black carbon [BC] for 48 hours of 200 healthy nonsmoker adult females who used biomass fuel for cooking. Exposure to PM2.5 and BC were measured using personal monitor, RTI MicroPEM (RTI International, NC) with an internal filter that had been both pre- and post-weighed to capture the deposited pollutants concentration. Lascar CO logger was used to measure CO. Endothelial function was measured by forearm blood flow dilatation response to brachial artery occlusion using RHI based on peripheral artery tonometry. A low RHI score (<1.67) indicates impaired endothelial function. Average 48 hours personal exposure to PM2.5 and BC were 144.15 $\mu g/m^3$ (SD 61.26) and 6.35 $\mu g/m^3$ (SD 2.18), respectively. Interquartile range for CO was 0.73ppm (0.62–1.35ppm). Mean logarithm of RHI (LnRHI) was 0.57 in current data. No statistically significant association was observed for LnRHI with PM2.5 (odds ratio [OR] = 0.97; 95% confidence interval [CI] = 0.92, 1.01; P = 0.16), BC (OR = 0.85; 95% CI = 0.72, 1.01; P = 0.07), and CO (OR = 0.89; 95% CI = 0.64, 1.25; P = 0.53) after adjusting for potential covariates. In conclusion, HAP was not associated with endothelial dysfunction among nonsmoking females in rural Bangladesh who used biomass fuel for cooking for years.

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1.57 Impact of Green Roof on Human Comfort Level and Carbon Sequestration: A Microclimatic and Comparative Assessment in Dhaka City, Bangladesh

B. A. Begum, R. Sultana, Z. Ahmed and M. A. Hossain

The study determines the impact of rooftop greening in an urban residential area in the microclimate context in Dhaka City Corporation, where the level of carbon sequestration from a green roof of an existing building and it's ability to reach the human comfort zone is focused. The study showed the nature of temperature variation between the green-roofed and bare-roofed buildings. Ten stations were chosen from the study area, where 20 buildings were studied, taking two neighboring buildings (a green- and a bare-roofed) from each station. Air temperature, relative humidity, and air velocity were collected from all floors and rooftops of the selected buildings. The Discomfort Index and Robaa Index have been measured to detect the human comfort

zone. Annual carbon sequestration by the plants of the green rooftops was assessed. Findings revealed a significant difference (1o ~ 3.5 °C) of the air temperature between the adjacent bare-roofed and green-roofed buildings. The thermal difference was significant during diurnal hours. The Discomfort Index and Robaa Index were lower in the green-roofed buildings than those of bare-roofed buildings. The annual carbon sequestration in the green roofs ranged from 20.6 tC/ha to 125.4 tC/ha, whereas the equivalent CO2 ranged from 84 to 460 t/ha.

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1.58 Respiratory Emergency Department Visits Associations with Exposures to $PM_{2.5}$ Mass, Constituents and Sources in Dhaka, Bangladesh Air Pollution

B. A. Begum, M. M. Rahman, K. Nahar, P. K. Hopke and G. D. Thurston

In this research work, we assessed $PM_{2.5}$ associations with respiratory emergency department (ED) visits in a biomass-burning-dominated high-pollution region and evaluated their variability by pollution source and composition. Time-series regression modeling was applied to daily ED visits from Jan. 2014 through Dec. 2017. Air pollutant effect sizes were estimated after addressing long-term trends and seasonality, day of week, holidays, relative humidity, ambient temperature, and the effect modification by season, age, and sex. $PM_{2.5}$ yielded a significant association with increased respiratory ED visits (0.84%; 95% confidence interval, 0.33-1.35%) per 10-μg/m3 increase. The $PM_{2.5}$ health effect size varied with season, the highest being during monsoon season, when fossil-fuel combustion sources dominated exposures. Results from a source-specific health effect analysis were also consistent with fossil-fuel $PM_{2.5}$ having a larger effect size per 10 μg/m3 than $PM_{2.5}$ from other sources (fossil-fuel $PM_{2.5}$: 2.79% [0.33-5.31%], biomass-burning $PM_{2.5}$: 1.27% [0-2.54%], and other $PM_{2.5}$: 0.95% [0.06-1.85%]). Age-specific associations varied, with children and older adults being disproportionately affected by the air pollution, especially by the combustion-related particles. This study provided novel and important evidence that respiratory health in Dhaka is significantly affected by particle air pollution, with a greater health impact by fossil-fuel combustion-derived $PM_{2.5}$.

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1.59 Characterization and Source Discovery of Wintertime Fog on Coastal Island, Bangladesh

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In this research work, An extensive chemical investigation of fog water's chemical composition, as well as source characterization, were carried out during the winter season (Dec. to Feb.) at an outflow location (Bhola, Bangladesh) of the Indo-Gangetic Plain (IGP).Characterization of the source involved correlational analysis, enrichment factor analysis, estimation of percentage sources, and air mass trajectory analysis. The average pH of fog water in Bhola was found to be 7.03 ± 0.02, demonstrating that acid-neutralizing components were successful in neutralizing acidifying species. The concentrations of the water-soluble ions were determined, and they were in the following order: Ca^{2+}>NO_3^- >Cl^->Na^+>SO_4^{2-}>NH_4^+>Mg^{2+}> K^+>F^->HCO_3^-. Of the six trace elements (Fe, Zn, Mn, Cu, Ni, Cr, Pb) that were analyzed, Zn ions were found in the highest concentration, followed by Mn ions. Neutralization factor analysis showed that the key neutralization components of fog-water were Ca^{2+} and NH^+. Enrichment factor (EF) calculation revealed the anthropogenic origin of NO_3^-, SO_4^{2-}, Zn, Mn, and Cu. This research has provided novel findings for the chemical characterization of fog water and the detection of its source at IGP outflow, and highlighted the anthropogenic contributions to local air pollution, as well as the transboundary influence on local air quality.

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1.60 Chemometric Appraisal of Water Quality for Domestic and Agricultural Purposes: A Case Study from establishing Rooppur Nuclear Power Plant (NPP) area, Pabna District, Bangladesh

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Water is the main sources for domestic purposes and as well as for both farming and industrial activities. Therefore, this study investigated the quality of groundwater at Ishwardi, Pabna district of Bangladesh.This

study showed that the heavy metals such as Pb, Cd, Cr, As, Ni, Cu, Zn, and Fe were remaining in trace amount. The groundwater quality index (*GWQI*), heavy metal evaluation index (*HEI*), heavy metal pollution index (*HPI*), and degree of contamination (C_d) revealed that all of the groundwater samples belonged to good quality condition for drinking purposes. This study revealed that pH, EC, TDS, salinity, Na^+, K^+, Mg^{2+}, Ca^{2+}, Cl^-, SO_4^{2-}, PO_4^{3-} and NO_3^- values in water samples are in tolerable limit according to Bangladesh (DoE) and international standards (WHO, IS, FAO, USEPA, UCCC). The irrigation water quality index (IWQI) revealed that majority of the groundwater samples were suitable for agricultural purposes. Classification based on Wilcox and US salinity hazard diagram indicated a consistent conclusion, which indicated that the water quality was in good condition for farming in the study area.

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1.61 Assessment of the Ecological Risk from Heavy Metals in the Surface Sediment of River Surma, Bangladesh: Coupled Approach of Monte Carlo Simulation and Multi-Component Statistical Analysis

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River sediment can be used to measure the pollution level in natural water, as it serves as one of the vital environmental indicators. This study aims to assess heavy metal pollution namely Copper (Cu), Iron (Fe), Manganese (Mn), Zinc (Zn), Nickel (Ni), Lead (Pb), and Cadmium (Cd) in Surma River.The potential ecological risk index values using Hakanson Risk Index (RI) and Monte Carlo Simulation (MCS) approach to evaluate the environmental risks caused by these heavy metals. in the study area. With obtained results, enrichment of individual heavy metals in the study area was found in the order of Ni>Pb>Cd>Mn>Cu>Zn. Also, variance in MCS index contributed by studied metals was in the order of Cd > Pb > Ni > Zn > Cu. None of the heavy metals, except Ni, showed moderate contamination of the sediment. Risk index values from RI and MCS provide valuable insights in the contamination profile of the river, indicating the studied river is currently under low ecological risk for the studied heavy metals. This study can be utilized to assess the susceptibility of the river sediment to heavy metal pollution near an urban core, and to have a better understanding of the contamination profile of a river.

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1.62 Multipotential Trace Metal Concentrations in Soil Associated with the Ecological and Human Health Risk near the Rooppur Nuclear Power Plant, Pabna, Bangladesh

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In this study, Soil samples were collected from ten sampling points surrounded the Rooppur Nuclear Power Plant to determine the metal concentration like As, Pb, Rb, Sr, Zr, Cu, and Zn. The metals concentrations in soil samples were determined by the Energy Dispersive X-ray Fluorescence (EDXRF) technique.The average metal concentrations in the study area were found in the following descend- ing order: Zr (334.84 mg/kg)>Rb (179.35 mg/ kg)>Pb (172.77 mg/kg)>Sr (138.86 mg/kg)>Zn (120.54 mg/kg)>Cu (16.96 mg/kg) > As (8.50 mg/ kg) respectively. Moreover, the sampling sites were organized according to the total metal concentration as S7>S3>S4>S5>S11>S2>S9>S1>S10>S8 >S12>S6 respectively. This study showed that the average concentration of As, Sr, and Cu surpassed the suggested standard and average shale value (ASV) limits. The geoaccumulation index (I_{geo}), enrichment factor (EF), contamination factor (CF) suggested that the study area was contaminated by only Pb and Zn. Subsequently, the assessment of human health risk suggested that both adults and children would not be exposed to the non-carcino- genic and carcinogenic risks as these remained under the corresponded threshold limits (1 and 10^{-6} to 10^{-4} respectively).

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1.63 Depth-related Dynamics of Physicochemical Characteristics and Heavy Metal Accumulation in Mangrove Sediment and Plant: Acanthus Ilicifolius as a Potential Phytoextractor

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The focus of this study was to determine the depth-wise variability of physicochemical properties (i.e., pH, TOC, TN, and EC), and heavy metals (i.e., Pb, Cu, Zn, As, and Cr) concentration, and the associated biological and ecological risks of the mangrove sediment.The accumulation of metal contents and the phytoremediation and phytoextraction were also investigated in a mangrove species, *Acanthus ilicifolius*.The mangrove sediment consists of a higher proportion of sand fraction (56.6 – 74.7%) followed by clay (10 – 28%) and silt (10.1 – 15. 7 %) fractions. The concentrations (mg/kg) of Pb, Cu, Zn, As, and Cr were ranged from 22.05 - 34.3, 8.58 -22.77, 85.07- 114, 5.56 - 12.91, and 0.98 - 5.12 in all the sediment layers. The hierarchy of the mean metal concentration in sediment was Zn (102 mg/kg)>Pb (25.6 mg/kg)>Cu (14.8 mg/kg)>As (8.79 mg/kg)>Cr (2.74 mg/kg) respectively. The examined metal concentrations were below the respective average shale values (ASVs). The degree of environmental, ecological, and biological risks was minimal according to various pollution indices like I_{geo}, *CF*, and *PLI*. The studied species exhibited the metal tolerance associated with two following strategies, metal exclusion, and metal accumulation. However, excess metal tolerance can impact the surrounding marine environment.

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1.64 Assessment of Heavy Metal Contamination in Sediment at The Newly Established Tannery Industrial Estate in Bangladesh: A Case Study

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This research work was focused to evaluate the concentration of heavy metals (i.e., Cr, Pb, Mn, Cu and Fe) in sediment samples collected from the Dhaleshwari River near the area of a newly established tannery industrial estate, Savar, Bangladesh.This study revealed that the metal concentration for chromium (Cr), lead (Pb), manganese (Mn), copper (Cu) and iron (Fe) were found to be 14.8–748 (186 ± 241) mg/kg, 2.38–21.1 (8.78 ± 6.15) mg/kg, 1.59–6.29 (3.12 ± 1.38) mg/kg, 0.36–4.75 (1.76 ± 1.47) mg/kg and 3.87–154 (42.7 ± 49.1) mg/kg (dry wt) respectively. The concentration of heavy metals in sediment samples descends with the following order: Cr > Fe > Pb > Mn > Cu. The spatial distribution pattern for the studied metals (Pb, Mn, Cu and Fe) showed that the maximum metals concentrations were found in the southeastern part, which was nearby effluent dumping zone. The ecological risk assessment in sediment samples revealed that there is no significant risk observed by the metal (oid)s at this moment. Considering Cr concentration, the modified hazard quotient (mHQ) showed that about 75% of the samples were low to severely polluted by Cr, while 25% of the samples were extremely polluted by Cr as well as $mHQ \leq 3.5$.

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1.65 Phytoremediation of Toxic Metals: A Sustainable Green Solution for Clean Environment

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Contamination of aquatic ecosystems by various sources has become a major worry all over the world. Pollutants can enter the human body through the food chain from aquatic and soil habitats. These pollutants can cause various chronic diseases in humans and mortality if they collect in the body over an extended period.Although the phytoremediation technique cannot completely remove harmful materials, it is an environmentally benign, cost-effective, and natural process that has no negative effects on the environment. The main types of phytoremediation, their mechanisms, and strategies to raise the remediation rate and the use of genetically altered plants, phytoremediation plant prospects, economics, and usable plants are reviewed in this review. Several factors influence the phytoremediation process, including types of contaminants, pollutant characteristics, and plant species selection, climate considerations, flooding and aging, the effect of salt, soil parameters, and redox potential. Phytoremediation's environmental and economic efficiency, use, and relevance are depicted in our work. Multiple recent breakthroughs in phytoremediation technologies are also mentioned in this review.

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1.66 A Case Study on Metal Contamination in Water and Sediment Near a Coal Thermal Power Plant on the Eastern Coast of Bangladesh

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This study has evaluated the potential ecological risk and human health risk for the contamination of nine elements (Cu, Cr, Mn, Zn, As, Pb, Co, Fe, and Sr) in water and sediment samples in two seasons, i.e., before and after rainy season, by calculating several pollution indices such as pollution load index (PLI), potential ecological risk (PER), and target hazard quotient (THQ).Samples were analyzed for elemental concentration using energy dispersive X-ray fluorescence (EDXRF) spectrometry. This study found that waters in the Kutubdia channel are safe and standard for aquatic organisms. In addition, the study area's elemental concentration in water and sediments is still safe but moderately enriched with Zn and Cu. The elemental concentration in water was observed to be high in the pre-monsoon season and vice versa in the sediment study. The result also reveals no potential ecological risk (PER< 4) in the study site. However, the health risk index showed a noncarcinogenic risk (THQ>1) for children and adults regarding the inhalation process where manganese was dominant. Apart from this, the pollution source was also identified by mul- tivariate statistical analysis, including cluster analysis (CA) and principal component analysis (PCA)– and a natural pollution source prevalent was found.

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1.67 Coupling of Redundancy Analysis with Geochemistry and Mineralogy to Assess The Behavior of Dust Arsenic as a Base of Risk Estimation in Dhaka, Bangladesh

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Exposure to dust particles enriched with arsenic (As) is a significant health threat for populations living in Southeast Asian megacities. The mineralogical composition of dust particles is the key factor that controls the retention and release of As.This study investigated the degree of metal(oid)s pollution (As, Ca, Fe, K, Ga, Rb, Sr, Ti, V, Y, and Zr) in road dust of Dhaka city, Bangladesh. Enrichment factor and geoaccumulation index suggested that the road dust was heavily enriched with As, which triggers a comprehensive investigation of its controlling mechanisms and potential health risks by combining physicochemical and mineralogical information with multivariate analysis and a simulated probabilistic risk estimation model. However, organic complexation can stabilize As on particle surfaces. Monte Carlo simulation-based health risk forecast suggested that the probability of As associated cancer risk has greatly exceeded the threshold value of 1E-4 for adults and children, and children are more vulnerable than adults. According to sensitivity analysis, the concentration of As and exposure duration (ED) posed the most significant impact (>58%) on risk estimation.

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1.68 Temporal Assessment of Heavy Metal Concentration and Surface Water Quality Representing The Public Health Evaluation from The Meghna River Estuary, Bangladesh

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The present study illustrated the seasonal variation of some physicochemical parameters and the four heavy metals (Cr, As, Cd, and Pb) distribution in the surface water of Meghna River estuary. It also evaluated the human health risk for adult and children due to directly contact with the surface water through ingestion and dermal pathways. The ranges of metal concentration in the study area were found in the descending order as: Cr (0.036–0.054; mean 0.045 ± 0.005)>As (0.012–0.036; mean 0.024 ± 0.007)>Cd (0.009–0.050; mean 0.018 ± 0.012)>Pb (0.007–0.014; mean 0.009 ± 0.007). In most cases, the concentrations of As, Cr, Pb, and Cd surpassed the guideline limits of human consumption. However, the one-way ANOVA study revealed that the average concentrations of the selected metals in the ten sampling sites were not significantly different at a 95% confidence level. The evaluated hazard quotient (HQ) and the hazard index (HI) for the investigated metal compounds were in the acceptable limit (<1).

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1.69 Contamination and Ecological Risk Assessment of Heavy Metals in Sediments of Two Major Seaports Along Bay of Bengal Coast

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The purpose of this study was to assess of the potential ecological risk index by some metals in sediments in the two majorseaports to understand the level of potential risks to the marine ecosystem. The results would be the scientific basis for building, control and mitigation measures during material dredging and submerging in the sea area of Bay of Bengal.In this study, nine heavy metals (Pb, Cd, Cr, Cu, Mn, Zn, As, Fe and Ni) in the surface sediment of two major sea ports from the Bay of Bengal Coast were measured and analyzed to estimate the degree of contamination and ecological risk for the first time. The average concentrations of heavy metals followed the decreasing order of Fe (53800±4002 mg/kg) >Mn (590±116.8 mg/kg)>Zn (67.59±13.5 mg/kg)>Ni (62.8±22.5 mg/kg)>Cr (36.59±7.22 mg/kg)>Cu (32.63±6.78 mg/kg)>Pb (16.78±3.93 mg/kg)>As (6.33±1.9 mg/kg)>Cd (0.71±0.16 mg/kg).Fe concentrations in both areas were significantly higher than those of other metals, and also the levels previously reported from neighboring areas. Besides, metals like Fe and Ni exceeded the recommended limit set by NOAA and EPA in maximum samples of both ports. However, except for one sampling point in Chattogram port, the pollution load index (PLI values were <1, indicating no heavy metal contamination. Enrichment factor (EF) values were also <1 for all metals except Cd, denoting the natural sources of metals except Cd. Besides, the contamination factor (CF) was 1<CF<3 for Cd and <1 for other metals, therefore the study area was under moderate risk for Cd contamination. The geo-accumulation index (I_{geo}) values indicated that the study area is moderately polluted with Cd (I_{geo}> 0). In addition, the potential ecological risk index (PERI) revealed that the both areas are under considerable (PERI>80) to moderate risk (PERI>40) due to Cd pollution. Correlation and Principal Component Analyses (PCA), demonstrated anthropogenic sources of some metals specially Fe, Ni and Cd. Therefore, it is recommended to follow-up of the study area to record the changes and to develop a pollution control strategy to mitigate future pollution risks.

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

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

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1.71 Diagnosis of Environmental Health at a Deltaic Mangrove Ecosystem: a Case Study for Sundarbans Mangrove Forest, Bangladesh

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The Ramsar site of the Sundarbans is located in the Ganges delta, which comprises huge constructive mangrove forests and major river deltas that feed into the Bay of Bengal. Around 10,000 km^2 of tidal halophytic mangroves make up Bangladesh's largest contiguous block. Its ecological health is very changeable, with physiochemical and nutritional profiles, due to the significant tidal influence and a confluence of freshwater. The objective of this study was to evaluate the present environmental health status of Sundarbans mangrove forest along withto explore different pollution indices understanding the heavy

metal contamination in water and river sediments and understand their sources. The physicochemical and nutrients concentration of surface water varies in different stations; Phosphate (PO_4) is low in concentration compared to Nitrate (NO_3), Ammonia (NH_3), and Silica (SiO_2). The Distribution maps created with the ArcGIS pro following the method of Inverse Distance Weighting (IDW) multivariate interpolation from the known value of sampling sites visualizes the most possible spatial distributions of each parameter. The Sundarbans mangrove water quality, according to the Water Quality Index (WQI), is of fair quality, which means that water quality is normally safeguarded but occasionally endangered or deteriorated; circumstances periodically deviate from natural or acceptable values. The mangrove quality index (MQI) classifies the Sundarbans as a moderate mangrove, which falls into category 3. Several indices for pollution and contamination, such as Pollution Load Index (PLI), Hazard Quotient (HQ), Modified Hazard Quotient (mHQ), Degree of Contamination (C_d), Geo-Accumulation Index (I_{geo}), Toxicity Risk Indicator (TRI) and Sediment Quality Guideline (SQG) gives a clear diagnostic result for water and sediment, that the current environment is in good condition having almost no or very minor contamination of heavy metals in the studied area of Sundarbans.

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1.72 Analysis of Heavy Metal Concentration of the Coral Ecosystem in Bangladesh to Evaluate the Ecotoxicity and Ecological Health

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The ecologically important with a lot of biological diversity, Saint Martin Coral Reef Ecosystem is with the keystone features as it is the first coral-oriented island of its chain at norther Bay of Bengal. The study area coincided with the newly established Saint Martin MPA by Ministry of Forest, Environment and Climate Change, thus this research aimed to monitor and evaluate the ecological condition through the assessment of associated indices in the study area for management plans.This study has focused on measuring the ecotoxicity by calculating several indices of sediment and water quality from the perspective of heavy metal concentrations. The toxicity assessment is a very necessary criteria to monitor the ecosystem. The coral ecosystem generally occurs at trophic region. They are very vulnerable even with the slight change of environmental parameters. The toxic elements have become a great concern for its adverse effects on ecological health. The present study has been investigated for ten of the commonly known heavy metals Arsenic (As), Mercury (Hg), Lead (Pb), Cadmium (Cd), Chromium (Cr), Nickel (Ni), Iron (Fe), Manganese (Mn), Copper (Cu), Zinc (Zn). The value found for these heavy metals indicates some locations are impacted with higher level of toxicity, that need to be taken care of finding the sources and controlling it. Analyzing the several indices such as Ecological Risk Index (ERI), Potential Ecological Risk Index (PER), Mean Effects Range Median (M-ERL M), Hazard Quotient (HQ), Toxicity Risk Indicator (TRI), Single Factor Pollution Index (SFPI), it is found the overall ecological health of Saint Martin Coral Reef is yet safe and in good condition but as some locations are found at alarming with potential risk of contamination, it is very much recommended to control the described potential sources.

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1.73 Vertical Distribution Profile and Ecological Risk Assessment of Heavy Metals Contamination in Sediment Cores Profile of PasurRiver Adjacent to The World's Largest Mangrove Forest, Bangladesh

T. R. Choudhury, M. R.Hasan*, M. Anisuzzaman*, M. N. Alam, M. M. Hosen, M. A. Maksud, S. R. Khan, L. N. Lutfa and S. B. Quraishi

Heavy metal pollution is a major global concern in environmental ecosystems due to its prevalence in nature, high toxicity, persistent nature, omnipresence, nonbiodegradability potential and bioaccumulation through the food chain.Sedimentary habitats or rocks are the world's largest single ecosystem, maintaining the trophic state of aquatic species.The aim of this study was to determine the qualitative and quantitative vertical distribution of heavy metals in core sediments from the Pasur River, as well as to estimate the possible ecological risk poses by heavy metals in sediment cores.Sediment samples were collected by using 1.5m long cylindrical sediment core (diameter: 4 cm) from 6 stations (marked as S1, S2, S3, S4, S5, S6) of the Pasur River for the heavy metals'levels assessment with the depth of sediment and the elemental (Pb, Cd, Cr, Cu,

Ni, Fe, As, Hg, Mn, Zn) analysis was done using atomic absorption spectrometer (AAS).According to the current findings, the mean concentrations of the analyzed elements were sorted in descending order as follows: Cd<As<Pb<Cu<Cr<Zn<Ni<Mn.Heavy metal content was higher in the upper layer (10-20 cm) than the middle layer (10-20 cm) and bottom layer (20-30 cm) of sediment core, with the exception of Fe, Ni, and Cu. Prospective ecological risk factor and risk index suggested that the analyzed heavy metals, with the exception of Cd, posed little ecological danger. Correlation matrix, cluster analysis and principal component analysis indicated that all studied heavy metals could have similar anthropogenic origins.

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1.74 Spatial Distribution and Risk Assessments Due to The Microplastics Pollution in Sediments of Karnaphuli River Estuary, Bangladesh

T. R. Choudhury, M.B. Hossain*and M. R. J. Rakib*

Marine and coastal ecosystems are constantly victims of continuous and accumulative stress from human and industrial activities. As a result of human and industrial activities, about 5–12 million tonnes of plastic waste enter various marine habitats each year, both from land and marine-based sources. microplastics (MPs) have become an emerging global pollutant due to their widespread dispersion and potential threats to marine ecosystems. However, studies on MPs in estuarine and coastal ecosystems of Bangladesh are very limited. Here, we aimed to conduct the first study on abundance, distribution, characteristics, and risk assessment of microplastics in the sediment of Karnaphuli River estuary, Bangladesh.Microplastic particles were extracted from sediments of 30 stations along the estuary by density separation and then enumerated and characterized using a stereomicroscope and Fourier Transform Infrared (FT-IR) spectroscopy. In the collected sediment of the Karnaphuli River estuary, the number of MPs varied from 22.29 to 59.5 items kg^{-1} of dry weight. The mean abundance was higher in the downstream and left banks of the estuary, whereas the predominant shape, colour, and size of MPs were flms (35%), and white (19%), and 1–5 mm (30.38%), respectively. Major polymer types were polyethylene terephthalate, polystyrene, polyethylene, cellulose, and nylon. MPs were found to pose risks (low to high) in the sediment of the estuary, with the highest risk occurring at one station near a sewage outlet, according to the results of risk analyses using the pollution risk index, polymer risk index (H), contamination factors, and pollution load index (PLI). The single value index, PLI, clearly demonstrated that all sampling sites were considerably polluted with microplastics (PLI> 1). H values showed toxic polymers, even in lower proportions, possess higher polymeric hazard scores and vice versa. This investigation uncovered new insights on the status of MPs in the sediments of the Karnaphuli River estuary, laying the groundwork for future research and control of microplastic pollution and management.

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1.75 Heavy Metal Contamination and Health Risk Assessment of Road Dust From Landfills in Dhaka and Narayanganj

T. R. Choudhury,M. Chakraborty*, M. A. Habib*, M. N Alam, M. M. Hosen, M. A. Maksud, S. R. Khan, L. N. Lutfa and S. B. Quraishi

Street dust, from the land fills area are the most important carriers of heavy metal contaminants usually considered as a valuable indicator of the air quality in an urban environment. This study was thus carried out to investigate the factors and processes controlling the airborne transferof toxic metals in dust, and their possible link to metal pollution. In this study, concentrations of heavy metals such as Pb, Cd, Cr, As, Cu, Ni, Zn and Mn were determined in road dusts collected from four landfill sites in Dhaka and Narayanganj to assess the contamination status and health risk. To evaluate the degree of accumulation of the heavy metals into the dust particles, the dust samples were sieved into three sizes: <300 - >150, <150 - >75 and <75 μm. Atomic absorption spectroscopy (AAS) was used to determine the concentrations of these heavy metals in the dust samples. The highest concentrations of Pb and As were found at Matuail landfills site, whereas Cd, Cr, Zn and Mn were found with their highest concentrations at Narayanganj landfills site. Concentration of Cu followed by Ni were found at elevated levels at Matuail medical waste incineration plant. According to the size-dependent results, the finer particles (<75 μm) had a higher degree of heavy metal accumulation. Height dependent results showed that the finer particles were deposited upright on the tree leaves. According to pollution load index, Matuail area quality was extremely degraded. For noncarcinogenic health risk, hazard quotient values for ingestion were higher compared to that of inhalation and dermal pathways. Hazard index

values of Matuail landfills and medical waste incineration sites (M-7 and M-13) were more than 1 for adult groups, where hazard index values for children group of sites M-7, M-13 and M-17 (Narayanganj landfills) were more than 1 and these were at least one order of magnitude higher than that of adult group. The results revealed that the children group may face more noncarcinogenic health risks at these sites.

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1.76 Microplastics in Sediment of Kuakata Beach, Bangladesh: Occurrence, Spatial Distribution, and Risk Assessment

T. R. Choudhury, P. Banik* and M. B. Hossain*

Microplastics (< 5 mm in size)were first reported in 1972 as an aquatic pollutant in marine environments, and now it has become a global concern for potential harmful effects not only on ecosystems but also on human health.Kuaklata beach, known as Daughter of Sea in Bangladesh, has drawn a growing number of tourists from all over the world, leading to the higher use of single plastic products. This study was a first attempt to describe the occurrence, spatial distribution, and ecological risk of microplastics (MPs) in Kuakata beach sediments.A total of 24 surface sediment samples were collected from the intertidal zone of the beach, and MPs were extracted using the density separation method and a stereomicroscope. Fourier transform infrared (FTIR) spectroscopy was used for qualitative and quantitative identification. The results revealed that the average MPs in the beach sediment were 232 ± 52 items kg−1 dry weight, which was much higher than many other sandy beaches throughout the world. Analyses of variance showed a significant ($p < 0.01$) difference among the mean abundance of MPs in sampling points. Fibers were dominated in every sampling point with an average of 123 ± 27 item kg−1. Most of the MPs observed were colored (60%), and the rest were transparent (40%). It was found that the size range of 1–5 mm MPs constituted over half (55%) of total MPs covering an average value of 127 ± 34 items kg−1. Three polymer types were identified in the sediment samples through FTIR analysis which followed the decreasing order of polyethylene terephthalate > polyethylene > polypropylene. Correlation analysis showed a positive relationship between the abundance of MPs and the finer grain size of sediment ($p = 0.055$; $r = 0.7$), indicating grain size-controlled the density of MPs. The pollution load index was assessed to estimate the ecological risk and found that the beach sediment of Kuakata belonged to the risk category I of the pollution index. This investigation provided preliminary information on MPs pollution in the marine ecosystem that the policymakers can use to take appropriate management approaches.

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1.77 Assessing sedimentological and Diagenetic Controls on Reservoir Quality of The Fluvio-Deltaic Miocene Surma Group Deposits Based on Core Sample Analysis of Fenchuganj Well 02

S. Hossain; Z. Alam*, M. Rahman*, J. H. Lupin*, M. K. Khalid, H. N. Das, S. M. Hoque, S. Akter and Y. N. Jolly

Miocene aged Surma Group deposits tend to have a different control setting on the reservoir quality and diagenesis in comparison with the older as well as slowly deposited sandstones. The study aim is to understand the impact of depositional sedimentology as well as post-depositional changes on Miocene reservoir rock. More specifically, the main objective is to study depositional and digenetic controls on reservoir quality based on core sample.In this research, Miocene aged fluvio-deltaic Surma Group sedimentshave been studied based on sedimentological analysis, thin section microscopy, scanning electron microscopy, X-Ray diffraction to understand the diagenesis and reservoir quality. Sedimentologicalfacies analysis study reveals the depositional environments of the sediments which are tidal, fluvial, barrier bar, deltaic. From the overall study it can be seen that mechanical compaction has played the major role on porosity-permeability reduction though dissolution of the minerals has created secondary porosity. Various clay minerals are present such as Kaolinite, Illite-Smectite, Chlorite. Scanning Electron Microscopy and X-Ray diffraction have provided the information of clay mineral presence. Alterations of grains have also been found. Sandstone samples are basically well sorted, fine grained, compacted and have good range of porosity which indicate that the reservoir quality of these sandstones are good.

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1.78 Ecological Risk Assessment of The Heavy Metals from Sediment of The Kuakata Coastal Area of The Bay of Bengal

S. Hossain, A. A.Mahmood*, T. Hamid*, K. M. Mamun, J. Kabir; S. Akter and Y. N. Jolly

Kuakata area is one the famous tourist spot in Bangladesh. Human activities may pollute the natural environment. Sediment is known as the ultimate sink of metals. So, in this research, there were 12 sediment samples collected from different locations in the Kuakata area, to assess heavy metal pollution status and associated ecological risk due to sediment. Presence of metals (Cu, Zn, Fe, Mn, Ti, Zr, and As) were detected using ED-XRF techniques. The concentration range of trace metals in sediment (mg/kg) followed the decreasing order: Fe (12530-25100)>Ti (4782-3118)>Mn (305.22-686.73)>Zr (249.29-110.49)>Rb (226.02-45.27)>Sr (181.35 -122.94)>Zn (151.46-75.25)>Cu (14.46-8.75)>As (8.92-5.35). Result of these metals will be assess after applying different geochemical indices such as Geo-accumulation index (Igeo), Pollution load index (PLI), Enrichment factor (EF), Contamination factor (CF) and different guidelines. The work is in progress.

*Maritime University, Bangladesh

1.79 Chemical Speciation of Trace Elements of Marine Sediment: A Case Study in The Coastal Area of Bangladesh

S. Hossain, A. A.Mahmood*, T. Hamid*, M. S. Rahman, S. Akter and Y. N. Jolly

Several (12) sediment samples were collected from the coastal area of Bangladesh. The purpose of this research is to determine bioavailable and potential mobile phases of trace elements after determining chemical speciation in the marine sediment of the coastal area and risk assessment.One set of samples were preserved in the laboratory in the air tight conditions. Another set of samples were kept at air dried conditions. Potential mobile mobile phases of Physical parameter of the samples (pH, EC, ORP) were measured. Chemical speciation will be investigated after applying a modified sequential extraction methods. Bioavailable phases (water soluble + Exchangeable+ Carbonate bound) will be determined and risk assessment will be calculated using Risk assessment code (RAC). The work is in progress.

*Maritime University, Bangladesh

1.80 Pollution Risk Assessment of The Marine Water at The Kuakata Coastal Area of The Bay of Bengal

S. Hossain, A. A.Mahmood*, T. Hamid*, M. S. Rahman, S. Akter, Y. N. Jolly and B. A. Begum

Several water samples were collected from the coastal area of Kuakata, Bangladeshto determine metal concentration and ecological risk assessment from marine water of the coastal area. Samples were preserved carefully after adding acid to avoid precipitation of the metals. Physical parameter of the samples (pH, EC, ORP) was measured. Trace metals of the waters will be determined by ICP-OES. Different pollution and geochemical indices will be applied to assess risk assessment. The work is in progress.

*Maritime University, Bangladesh

1.81 Chemical Speciation of Arsenic and Other Trace Elements in The Subsurface Sediment of The Bengal Delta: A case Study in Jessore, Jhenaidah and Chuadanga

S. Hossain; K.J. Fatema; S. Akter;M.S. Rahman; Y. N. Jolly; B. A. Begum

After determining arsenic risk in the shallow (<150 m) ground water in the most of the places of Bangladesh, use of deep (>300m) water has been increased. Though groundwater of various places in the Bengal Delta of Bangladesh are less contaminated than flood plain area, still several places are contaminated with arsenic and other metals such as Fe and Mn. Objective of this work is to determine mobile phases of arsenic and other trace elements of the sediment to observe leaching in to groundwater. Several types of data (Bore log, water chemistry, rainfall, water level etc.) were collected from different local organizations (DPHE, BWDB) and report (JAIICA). Several maps were developed based on available collecting data using GIS and rockworks software. Groundwater of Jhenaidah area is less contaminated than Jessore and Chuadanga area. To understand mechanism of the leaching of As and other metals, it will be determined chemical speciation (mobile phases) after applying operationally determined sequential extraction technique. Collected geochemical fractions will be determined using ICP-OES.

Clinical Chemistry

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

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

Rural villagers are often seen to suffer from various diseases including kidney diseases, diabetics, hypertension at premature age. The possibility is that the continuous contamination of our environment by various heavy metals has a strong role there. This project will help to find out the possible relations.The current investigation has been based on the analysis of Pb and Cd in human excretion like urine, body fluid e.g. blood serum and the presence of same elements in the components of environment e.g water, in which the target persons reside by. Until now 203 urine samples and 9 water samples has been analyzed for the presence of Pb and Cd with atomic absorption spectroscopy (AAS). In addition, 154 blood serum has been collected and in the process of analysis.

*National Institute of Kidney Diseases and Urology, Dhaka

1.83 Accreditation of The Method for The Determination of Copper in Urine for The Detection of Wilson's Disease

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

Wilson's disease is a rare disease that causes malfunctioning of brain, liver, eye etc. damage in humane body and threatens life. Presence of higher amount of Cu in body and consecutive excretion through urine is usually considered as an indication of this disease. Previously a method was developed in the laboratory. The goal of the current project was to get accreditation of the method.After validation the method has been in use and found to be effective in terms of determination of the suspected patients as well as the satisfaction of the patients. Hence, relevant documents have been submitted to Bangladesh Accreditation Board (BAB). After careful review, they have found the documents satisfactory and approved accreditation of the scope in the laboratory.

1.84 Assessing the Levels of Selected Essential (Zn, Mg) and Toxic Elements (Pb, Cd) in Patients with Different Stages of Chronic kidney Disease

S. B. Quraishi, Dr. M. A. Anwar, M. A. A. Chowdhury, M. N. Alam, M. M. Hosen, M. A. Maksud, S. R. Khan and L. N. Lutfa

Deficiency of essential elements and excess of potentially toxic elements are common in patients with chronic kidney disease (CKD). Whether these abnormalities are associated with poor outcomes isunknown but worth investigating, because they are potentially treatable. The aim of this study was to assess the levels of some selected essential and toxic elements in the serum of different stages of CKD patients. Using a case serial design, 87 pre diagnosed CKD patients were included in this study. Serum levels of Zinc and Magnesium as essential elements and serum levels of lead and Cadmium as toxic elements were measured in fasting serum sample by flame atomic absorption spectrometry (F-AAS) and graphite-furnace atomic absorption spectrometry (GF-AAS) by Varian Atomic Absorption Spectrometer respectively. Among the 87 participants 20.70%(n=18) had stage 1-3 CKD, 28.70% (n=25) had stage 4 CKD, 16.10% (n=14) had stage 5 CKD and 34.5% (n=30) had satge 5 CKD on maintenance hemodialysis. The mean age of the study subjects was 48.96±12.35 years and 52.90% were male. The mean value of Zn, Mg and Pb, Cd were 453.60±49.30 mcg/L, 13.90±1.40 mg/L and 92.85±9.30 mcg/L, 6.00±0.36 mcg/Lrespectively. Serum levels of Mg and Zn were significantly and progressively low in CKD patients from stage 1-5 and hemodialysis. Conversely serum levels of Cd and Pb were progressively high in CKD patient from stage 1-5 and hemodialysis. Further studies with larger population from multiple centers are needed to clarify the changes of these elements.

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1.85 Arsenic Measurement: A Glimpse of Arsenicosis Patient in Bangladesh

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

To help diagnose Arsenicosis patients by measuring the level of arsenic in scalp hair using EDXRF technique which eventually allows to have a glimpse of arsenicosis patients in Bangladesh.As part of its commitment,

Chemistry Division of Atomic Energy Centre Dhaka is devoted in providing unique and significant services to the people of the nation for more than 30 years. Arsenic measurement is one of them. Scalp hair is chosen for the purpose because, hair tissue is a good biological indicator for chronic arsenic exposure. During the stipulated period, Jul. 2021 – Jun. 2022, a total of 128 patients, where the number of males is slightly ahead of females, have been reported. Of them, a significant number, predominantly from the age group 41-50 yrs, have been found with arsenic more than the normal level which is 3.0 mg/kg and 14.53 mg/kg is the highest value derived from a 50 year old man from Noakhali.

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

Name of the person	Title of the event	Organizer	Date	Place
Dr. S. B. Quraishi	International Conference on Physics	BPS	19-21 May 2022	AEC, Dhaka
Dr. Y. N. Jolly	Regional Training Course on Sample Preparation and Analyses of Stables Isotopes in Wetland Samples	International Atomic Energy Agency	1-2 Dec. 2021	Virtual Mode
	International Conference on Electronics and Informatics-2021	Bangladesh Electronics and Informatics Society	27-28 Nov. 2021	AEC, Dhaka
	International Conference on Physics-2022	Bangladesh Physical Society	19-21 May 2022	AEC, Dhaka
M. S. Rahman	International Conference on Electronics and Informatics - 2021	Bangladesh Electronics and Informatics Society	27-28 Nov. 2021	AEC, Dhaka
	International Conference on Physics 2022	Bangladesh Physical Society	19-21 May 2022	AEC, Dhaka
M. J. Kabir	Regional Training Course on Sample Preparation and Analyses of Stables Isotopes in Wetland Samples	International Atomic Energy Agency	1-2 Dec. 2021	Virtual Mode
	International Conference on Electronics and Informatics-2021	Bangladesh Electronics and Informatics Society	27-28 Nov. 2021	AEC, Dhaka
	International Conference on Physics-2022	Ministry of Industries	19-21 May 2022	AECD, Dhaka
Dr. T. R. Choudhury	International Conference on Electronics and Informatics	BES	27-28 Nov. 2021	AEC, Dhaka
	International Conference on Physics	BPS	19-21 May 2022	AEC, Dhaka
Dr. S. Akter	International Conference on Electronics and Informatics-2021	Bangladesh Electronics and Informatics Society	27-28 Nov. 2021	AEC, Dhaka
	IAEA/RCA RAS7037 Regional Training Course on Design and Implementation of Wetland Isotope Programmes	International Atomic Energy Agency (IAEA)	28-29 Jul. 2021	Vienna, Austria (Virtual)

Name of the person	Title of the event	Organizer	Date	Place
A. R. M. Tareq	International conference on Electronics and Informatics	BEIS	27-28 Nov. 2021	AEC, Dhaka
	International conference on physics	BPS	19-21 May 2022	AEC, Dhaka
Dr.S. Hossain	Radioactive waste disposal in Japan, especially focused on geological disposal of high-level radioactive waste	JAEA, Japan	6 Oct. 2021	JAEA, Japan (via Zoom)
	International Underground Built Heritage Mini Symposium	Bilateral research group of JSPS(Japan) and CNR (Italy)	26 Mar. 2022	Taya Cave, Yokohama, Japan, (Zoom Platform)
	International Conference on Physics, 2022	Bangladesh physical society	19-21 May 2022	AEC, Dhaka
M. N. Alam	International Conference on Electronics and Informatics	BES	27-28 Nov. 2021	AEC, Dhaka
	International Conference on Physics	BPS	19-21 May 2022	AECD
	Bangladesh-US Training Programme (Virtual) on Understanding the ISO Laboratory Accreditation Process	BTF	14-15 Sept. 2021	Virtual Platform
	Bangladesh-US Training Programme (Virtual) on Virtual Workshop to Validate Laboratory Test Report Generation, Transfer, and Automation Process of BAEC	BTF	18 May, 2022	Virtual Platform
	IAEA/RCA Training Workshop on data interpretation in combination with project progress review meeting	IAEA	21-24 Nov. 2021	Virtual Platform
	Workshop on Innovation Concept	Planning Division, BAEC	May 2022	BAEC HQ
K. M. Mamun	28th BAB Assessor Training Course on ISO/IEC 17025:2017	Ministry of Industries	26-30 Sept. 2021	Bangladesh Accreditation Board (BAB), Ministry of Industries
	IAEA/RCA RAS7037 Regional Training Course on Design and Implementation of Wetland Isotope Programmes	International Atomic Energy Agency (IAEA)	28-29 Jul. 2021	Vienna, Austria Virtual Platform
	International Conference on Electronics and Informatics-2021	Bangladesh Electronics and Informatics Society	27-28 Nov. 2021	Atomic Energy Centre, Dhaka

Name of the person	Title of the event	Organizer	Date	Place
	International Conference on Physics-2022	Bangladesh Physical Society	19-21 May 2022	Atomic Energy Centre, Dhaka
R. Sultana	International conference on Electronics and Informatics	BEIS	27-28 Nov. 2021	AECD
	International conference on physics	BPS	19-21 May 2022	AECD
M. M. Hosen	International Conference on Electronics and Informatics	BES	27-28 Nov. 2021	AECD
	International Conference on Physics	BPS	19-21 May 2022	AECD
	BAB Assessor Training Course on ISO/IEC 17025:2017	BAB	26-30 Sept. 2021	NPO Seminar Hall, BAB, Dhaka
	IAEA/RCA Training Workshop on data interpretation in combination with project progress review meeting	IAEA	22-24 Nov. 2021	Virtual Platform
	Bangladesh-US Training Programme (Virtual) on Strengthening Chemical Security and Secure Chemical Management at Different Public and Private Sectors in Bangladesh	BTF	25-26 Nov. 2021	Virtual Platform
	IAEA/RCA Training Workshop on data interpretation in combination with project progress review meeting	IAEA	21-24 Nov. 2021	Virtual Platform
M. A. M. Sarkar	International Conference on Electronics and Informatics - 2021	Bangladesh Electronics and Informatics Society	27-28 Nov. 2021	AEC, Dhaka
	International Conference on Physics 2022	Bangladesh Physical Society	19-21 May 2022	AEC, Dhaka
M. Hasan	International Conference on Electronics and Informatics - 2021	Bangladesh Electronics and Informatics Society	27-28 Nov. 2021	AEC, Dhaka
	International Conference on Physics 2022	Bangladesh Physical Society	19-21May 2022	AEC, Dhaka
M. F. Ehsan	International conference on Electronics and Informatics	BEIS	27-28 Nov. 2021	AEC, Dhaka
	International Conference on Physics 2022	Bangladesh Physical Society	19-21May 2022	AEC, Dhaka

3. Collaboration Work(s)

- IAEA/RCA RAS-7031 : Assessing the Vulnerability of Coastal Landscapes and Ecosystems to Sea-Level Rise and Climate Change (RCA)
- IAEA/RCA RAS7037 : Enhancing Wetland Management and Sustainable Conservation Planning (RCA)

4. Special Allocation Grant Project

- Special Allocation Grant Project MOST (MOST-ES-435/1182) of Ministry of Science & Technology entitled "Building capacity in determining carcinogenic metals in environmental and biological samples in arsenic affected area and it's probable correlation with cancer", (Jul. 2021 to Jun. 2022).
- R & D Grant 2021-22-MOST (Reg-4): Apportionment of Carcinogenic Arsenic (III & IV) in Water using Atomic Absorption Spectrophotometer (AAS) and Estimation of Associated Human Health Risk

5. StakeholderMeeting

Exchange of view' Seminar with the STAKEHOLDERS on "Diagnosis of Wilson's Disease Using ISO/IEC 17025:2017 Accredited Test Method", 21 Jun. 2022, AECD Auditorium, Participant-90.

6. Service Rendered and Revenue Income

6.1 Analytical Services

Name of organization	Type of sample	No. of samples	Revenue income
Patients from different hospitals and clinics	Urine	2027*	15,84,000/-
Bangladesh Food Safety Authority (BFSA)	Pesticide, crops & soil	51	3,06,000/-
Patients from different hospitals and clinics	Serum	9	13,500/-
Transcom Distribution Co. Ltd.	Milk	8	16,000/-
Dhaka Water Supply and Sewerage Authority	Water	4	18,000/-
Ummay Salma	Water	2	8,000/-
Panna Battery Ltd	Sulfuric Acid	3	57,500/-
Crescent Chemicals Ltd.	Sulfuric Acid	2	18,500/-
Department of Livestock, QC Lab	Food	1	2,500/-
Bangladesh Rice Research Institute, Gazipur	Rice Powder	1	9,000/-
Dr. Md. Amirul Islam	Plant	3	6,000/-
Brac James P Grant School of public Health	Salt	1	4,000/-
Urine sample		47	-
Ministry of Women and Children Affairs	Gold	5	12,500/-
Ministry of Public Administration	Gold	13	32,500/-
Ministry of Women and Children Affairs	Gold	5	12,500/-
Ministry of Fisheries and Livestock	Gold, Silver	21	46,500/-
Bangladesh Bank	Gold	2	5,000/-
Amin Jewellers	Gold	1	2,500/-
Ministry of Youth and Sports	Gold	88	220,000/-
Ministry of Information and Communication Technology	Gold	10	25,000/-
Ministry of Industries	Gold	2	5,000/-
Ministry of Local Government Rural Development & Cooperatives	Gold	11	27,500/-
Ministry of Women and Children Affairs	Gold	5	12,500/-
Ministry of Women and Children Affairs	Gold	5	12,500/-
Ministry of Youth and Sports	Gold, Silver	80	180,000/-
Ministry of Foreign Affairs	Gold	2	5,000/-
Bangladesh Bank	Gold	1	2,500/-
Bangladesh Bank	Gold	2	5,000/-

Name of organization	Type of sample	No. of samples	Revenue income
Bangladesh Bank	Gold, Silver	2	4,500/-
University of Dhaka	Gold	1	2,500/-
Amin Jewellers	Gold	1	2,500/-
Ministry of Cultural Affairs	Gold	24	60,000/-
Bangladesh Election Commission Secretariat	Gold	3	7,500/-
LI & FUNG (Bangladesh) LTD.	Gold	1	2,500/-
Cabinet Division	Gold	12	30,000/-
Ministry of Information and Broadcasting	Gold	32	80,000/-
Cabinet Division	Gold	1	2,500/-
Export Promotion Bureau	Gold, Silver	51	116,000/-
Ministry of Local Government, Rural Development and Co-Operatives	Gold	30	75,000/-
Bangladesh Shishu Academy	Gold, Silver	50	110,000/-
Bangladesh Folk Arts and Crafts Foundation, Ministry of Cultural Affairs	Gold	4	10,000/-
Different Hospitals and Clinics	As	128	127,000/-
Geological Survey of Bangladesh, Ministry of Power, Energy and Mineral Resources	K, Ca, Ti, Mn, Fe, Ni, Cu, Zn, As, Zr, Pb	45	171,000/-
Sonahat Land Customs, Bhruangamari, Kurigram	Ca, V,Mn, Fe, Co, Ni, Cu, Zn, Rb, Sr, Zr	1	3,800/-
Total		2798	34,54,300/-

6.2 Analytical Services (For RNPP)

Name of organization	Type of sample	No of samples	Parameter	Test Performed/ season	Test Performed	Revenue income
RNPP Costruction Project	Drinking Water	5	25	125	375	Free of cost
	Surface Water (Gross contents)	44	24	1056	3168	
	Surface Water (soluble)	44	11	484	1452	
	Vegetation	25	11	275	825	
	Aquatic Vegetation	15	11	165	495	
	Soil	12	22	264	792	
	Sediment	18	14	252	756	
	Milk	5	11	55	165	
	Meat	5	11	55	165	
	Fish	5	11	55	165	
	Grass	12	11	132	396	
	Feed	15	11	165	495	
Total		204	-	3081	9243	

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, FPGA based system and robotic 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 Nuclear Radiation Monitoring System (NRMS) using Internet of Things (IoT)

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

Nuclear radiation monitoring system (NRMS) is essential for acquiring and storing environmental radiation data around the nuclear facilities. An Internet of Things (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 objective of this work is to design an IoT based system for acquiring nuclear radiation data from the environment as well as monitoring and storing it remotely using web-based user interface.

In this work, a nuclear radiation monitoring system (NRMS) based on IoT is proposed. A prototype of the proposed system has been developed, which has two major parts: one is radiation detection unit (RDU) and another one is wireless communication unit (WCU). RDU consists 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 RDU. WCU transmits the acquired radiation data to the database server through NodeMCU which is an open-source firmware and development board specially targeted for IoT based applications. A web-based user interface (ThingSpeak) is used to aggregate, visualize, and analyze radiation data streams in the cloud. It is observed that the proposed system can detect the presence of nuclear radiation level of the environment remotely. An app for Smartphone using Blynk and an application software for PC using LabVIEW to monitor the nuclear radiation level have been developed. Further, the development of web server, data analysis, calibration and testing are ongoing.

1.2 Development of Atmospheric Pressure Plasma Jet (APPJ)

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

Atmospheric pressure plasma jet (APPJ) is a plasma device that can be run under atmospheric-pressure at various gases and is technically simple, low-cost, and environment-friendly and usefulness of small size in treating localized regions. APPJ has wide application fields including material deposition, etching, surface modification, sterilization, and biomedical treatment. Therefore, this work is intended to present the development of APPJ with a stable, homogeneous, and uniform plasma discharge at atmospheric pressure and very low temperature.

In an APPJ system, however, the power supply is considered to one of the significant components, as it plays a key role on the discharge characteristics of the APPJ. The generation of APPJ by flowing gas in a dielectric tube wrapped with tube-shaped electrodes needs of pulses (several microseconds) with a high voltage (several kV) and a low repetition rate (several kHz). In this work, a compact high voltage, energy efficient pulse generator is employed to generate atmospheric-pressure plasma jet. The APPJ is arranged in a single electrode configuration, where only HV voltage electrode is used and ground electrode is virtual. It is considered that the performance of the APPJ will be tested by generating a stable room-temperature atmospheric pressure plasma plume using He gas or air flow in the plasma jet device as a future works. This is an ongoing work and it is expected that this study will stimulate the further investigations on the development of APPJ discharge processes.

[*]Graduate School of Engineering, Kochi University of Technology, Kochi, Japan

1.3 A Unipolar Pulsed DC Generator for Electrical Gas Discharge

M. A. A. Mamun, M. A. Rahman, S. Sattar, M. T. Khatun, A. Begum and A. Hatta[*]

Electrical gas discharge (EGD) is widely used in the various application fields such as in micro-electronics industry and in materials technology for surface treatment, etching, coating, fabrication of integrated circuits, deposition of thin films and so on. Generally, EGD is a kind of plasma and is produced by applying a potential difference of a few 100 V to a few kV between two electrodes kept at a specific distance within a tube or a reactor. The electrical characteristics of a gas discharge are significantly influenced by the power delivered from the generator. Different types of power generators such as direct current (DC), radio frequency (RF), microwave and pulsed DC are usually employed for EGD. Among these, it is supposed that pulsed DC power can considerably contribute in discharge characteristics such as changing the gas phase chemistry, energy of ions, electron density, and electron temperature by varying the pulse parameters such as amplitude, frequency and duty cycle. In this study, a pulsed DC generator (PDG) is proposed that is basically designed for low pressure plasma discharge applications in a vacuum chamber.

The power supply mainly consists of a high voltage DC supply connected to an energy storage capacitor employing as primary energy source, a low voltage pulse generator associated with driving circuits for generating the trigger signals of the power switches and a half-bridge switching circuit arranged in a constant current control mode for delivering controlled power to the load. This generator was successfully employed to carry out electrical discharge experiments inside a vacuum chamber using argon (Ar) gas. The developed PDG can generate unipolar (negative) pulse trains of with variable pulse parameters in such a way that the output peak voltage could be adjusted by varying the dc input voltage as well as both the pulsed width and frequency could be tuned by altering the triggering signals to the power switches. The experimental results revel that the developed PDG is suitable to perform low pressure electrical gas discharge which can be used in deposition of thin films.

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

1.4 Using Surface Electromyographic Signal to Assess Fractal Dimension from Biceps Brachii Muscle Based on Different Elbow Joint Angles

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

Analysis of the complexity and variability from the biomedical physiological time series data raises significant interest as a promising and sensitive marker of abnormality or impairment assessment in muscle physiology, especially in electromyography (EMG) signal. This work aimed to measure subject-specific (*i.e.*, individual) fractal dimension as a quantitative measure of complexity of EMG signal (*i.e.*, detecting long-range correlations in noisy signal) from upper limb bicep brachii (BB) muscle during five elbow joint angles movement (at 0°, 30°, 60°, 90° and 120°).

The EMG signal was recorded from ten healthy (mean±SD age: 22.4±1.5 years) participants using wearable sensor. The fractal scaling (α-values) of the EMG time series was assessed using a non-linear technique called detrended fluctuation analysis (DFA). Majority of the results show that DFA α-values at each angle exhibit anti-correlated (*i.e.*, DFA $\alpha < 0.05$) behavior. Few results show positive correlation (*i.e.*, DFA α between 0.53 to 0.77), but none of the α values have 1.0 (strongly correlated/pink noise). No significant difference exits between the elbow angles except one case, *i.e.*, 0° vs. 30° ($p < 0.05$). This DFA-based complexity measuring results from EMG signal holds promise for rehabilitation of control of upper limb muscle activation patterns.

[*]Department of Software Engineering, Daffodil International University (DIU), Dhaka, Bangladesh
[**]Department of Computer Science, American International University-Bangladesh (AIUB), Dhaka, Bangladesh

1.5 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

Main objective of present work is to 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 BLHelli 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. Due to the poor flight stability of KK 2.1.5 flight controller, it was replaced by an upgraded one Pixhawk PX-4 which is more stable and reliable. Mission Planner software is used for setup, configuration and calibration of various flight parameters of Pixhawk PX-4 flight controller. After replacing the flight controller, the quad-copter is providing better flight stability. Future plan is to incorporate a GM-survey meter along with data acquisition, logging and transmission facilities with the designed UAV.

1.6 Radiation Detection and Measurement using a Robotic System with Raspberry Pi

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

Objective of the work is to design and develop a robotic system for radiation dose measurement with Raspberry Pi in and around the nuclear and radiation environment to ensure human safety. The purpose of the robot is to assist the radiation workers from getting unwanted radiation exposure. The system includes a ground vehicle, GM tube based radiation counting unit, Raspberry Pi, Pi camera module and web based controlling and monitoring unit. With the developed system, the robot is controlled from a server to be moved towards a desired location and measure radiation level. The system is working properly.

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

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

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

In this work, we have used Arduino UNO, MQ-135 air quality sensor, LCD, breadboard, jumper wires, and potentiometer. The Arduino Uno is a modern microcontroller board based on the ATmega328P. It is simply related to a computer by a USB link or power. Using jumper wires the MQ135 gas sensor unit is linked to the Arduino Uno board. The MQ135 gasoline sensor can detect a huge variety of the gases like NH3, alcohol, benzene steam, co2

1.8 Using Surface Electromyographic Signal to Assess Fractal Dimension from Biceps Brachii Muscle based on Different Elbow Joint Angles

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

Analysis of the complexity and variability from the biomedical physiological time series data raises significant interest as a promising and sensitive marker of abnormality or impairment assessment in muscle physiology, especially in electromyography (EMG) signal. This work aimed to measure subject-specific (*i.e.*, individual) fractal dimension as a quantitative measure of complexity of EMG signal (*i.e.*, detecting long-range correlations in noisy signal) from upper limb bicep brachii (BB) muscle during five elbow joint angles movement (at 0°, 30°, 60°, 90° and 120°).

The EMG signal was recorded from ten healthy (mean±SD age: 22.4±1.5 years) participants using wearable sensor. The fractal scaling (α-values) of the EMG time series was assessed using a non-linear technique called detrended fluctuation analysis (DFA). Majority of the results show that DFA α-values at each angle exhibit anti-correlated (*i.e.*, DFA $\alpha < 0.05$) behavior. Few results show positive correlation (*i.e.*, DFA α between 0.53 to 0.77), but none of the α values have 1.0 (strongly correlated/pink noise). No significant difference exits

between the elbow angles except one case, *i.e.*, 0° vs. 30° ($p < 0.05$). This DFA-based complexity measuring results from EMG signal holds promise for rehabilitation of control of upper limb muscle activation patterns.

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

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

1.9 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

Main objective of present work is to 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 and smoke and other diverse dangerous gases which are present in the air. The sensors' analog pin is related to the analog pin 0 and the digital pin to digital 8 on the Arduino board. When we give power supply to this device then it starts working, which means that after receiving power supply 5v the MQ 135 sensor starts detecting the quality of air within a limited range. After that, it will send information to LCD about the level of pollution in ppm. This is an ongoing work.

1.10 Microcontroller-Based Portable ECG Detection System using LabView

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

The work's aim is to design and develop an embedded system for ECG detection that will be portable and cost-effective.Nowadays heart disease is a very common disease in the world. To identify heart disease, ECG is the first diagnosis process. Maximum ECG detection is very costly and non-portable. As it is a very common disease, we need a portable and cost-effective ECG detection system. In this study, a microcontroller, and an ECG sensor (Single Lead Heart Rate Monitor- AD8232) are used to develop a system with LabView software. It is an ongoing project.

1.11 Heart Disease Prediction using Machine Learning

A. Begum, M. R. Sarker*, M. A. A. Mamun and M. Begum

The objective of the work is to develop a model based on the previous record data which can be used for the prediction of either heart disease is present in a patient or not. Heart disease, alternatively known as cardiovascular disease, encases various conditions that impact the heart and is the primary basis of death worldwide over the span of the past few decades. It associates many risk factors in heart disease and a need for the time to get accurate, reliable, and sensible approaches to make an early diagnosis to achieve prompt management of the disease. Data mining is a commonly used technique for processing enormous data in the healthcare domain. Researchers apply several data mining and machine learning techniques to analyze huge complex medical data, helping health care professionals to predict heart disease. This study presents various attributes related to heart disease, and the model on basis of supervised learning algorithms such as logistic regression, SVM, decision tree, K-nearest neighbor, and random forest algorithm. It uses the existing dataset from the Kaggle.com of heart disease patients. The dataset comprises 918 instances and 11 attributes which are used to perform algorithms. This study aims to envision the probability of developing heart disease in the patients. It is an ongoing project.

*Institute of Leather Engineering and Technology, University of Dhaka

2. Repair and Maintenance, Renovation Work

During the period major instruments (scientific, industrial and nuclear) of AECD have been repaired. The major instruments include repair X-ray control Panel, High speed centrifuges, Hot Plate, Survey meter (Gamma-Scout), Computers, (System Unit with software installation), 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.List of repair and maintenance work(s) are as follows

Type of the instruments	Name of the user	Quantity
Scientific, Nuclear and Analytical	AEC, Dhaka	07
Computer (System Unit with software installation)	AEC, Dhaka	15
Intercom System (Line & Set)	AEC, Dhaka	05

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

Title of the event	Date	Place	Number of participant
Industrial Attachment Training programme 2021	19 Dec. 2021- 16 Mar. 2022	Electronics Division, AECD	9
Design and development of a wireless robotic system for measuring radiation	18 Apr. 2022	Auditorium, AECD	37

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

Name of the participant	Title of the event	Organizer	Date	Place
M. Begum	International Conference on Electronics and Informatics-2021	BES	27-28 Nov. 2021	AECD
H. Akhter	International Conference on Electronics and Informatics-2021	BES	27-28 Nov. 2021	AECD
S. Sultana	International Conference on Electronics and Informatics-2021	BES	27-28 Nov. 2021	AECD
M. A. A. Mamun	International Conference on Electronics and Informatics-2021	BES	27-28 Nov. 2021	AECD
M. A. Rahman	International Conference on Electronics and Informatics-2021	BES	27-28 Nov. 2021	AECD
S. Sattar	International Conference on Electronics and Informatics-2021	BES	27-28 Nov. 2021	AECD
M. T. Khatun	International Conference on Electronics and Informatics-2021	BES	27-28 Nov. 2021	AECD
A. Begum	International Conference on Electronics and Informatics-2021	BES	27-28 Nov. 2021	AECD

Experimental Physics Division, AECD

Objective/Introduction

The objective of the division is to develop solar energy materials and advanced materials in thin film form for photovoltaic, optoelectronic and nuclear detector applications by deposition and characterization techniques. The fabrication of photo detectors materials and their characterization and studies of the fundamental properties of solid-state materials are also objectives of the division. The device grade thin film materials are the key objective of the division.

Programme

- Preparation and characterization of SnS_2, SnS thin film deposited by spin coating.
- Preparation and characterization of $CuGaSe_2$**,** ZnSe, Al doped ZnSe, Mn doped ZnSe, Ag doped ZnSe, CdTe thin films by thermal evaporation.
- Preparation and characterization of Cr doped ZnS, CuO,ZnS, CdSe, CdS Thin film deposited and CdS, SnS_2 Solution, ZnO Nano particle synthesized by chemical bath deposition.
- Study of photo detector materials of thin films.
- Study of p-type absorbs layers of CdTe thin films.
- Nuclear detector thin film materials study.

Activities

1. Research and Development Work(s)

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

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

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

Current progress: Undoped and 1%, 1.50%, 2%, 2.5% Al doped ZnSe Thin film were prepared by thermal evaporation technique. ZnSe thin films of thickness 500 nm & substrate temperature S_T = 250^{0}C & annealing temperature A_T =230^{0}C with annealing time 1 hour is prepared by thermal evaporation method. Optical properties were characterized by UV-VIS-NIR spectroscopy. The most important parameter optical band gap estimated on this research work. Structural parameters such as crystallite size, stress, strain, dislocation density was obtained from the XRD data using different models. Elemental measurement was observed by FTIR. ZnSe films thickness were calculated and synthesis and Analysis of the parameters are going on.

1.2 Investigation of the Transport Properties of Vacuum Evaporated Thin films of Copper Gallium DI-Selenide ($CuGaSe_2$)

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

Objective: Analysis of structural, optical and electrical properties of $CuGaSe_2$ thin film.

Current progress: Thin films of copper gallium di-selenide ($CuGaSe_2$) were prepared in vacuum (10^{-6} mbar) by Stacked Elemental Layer (SEL) deposition method. This stack was then thermally annealed insitu to form a compound, copper gallium di-selenide (CuGaSe2) which is dependent on the thermal annealing temperature (A_T) and duration (A_t). These parameters have been optimized by measuring transport properties, like conductivity, charge carrier concentration and mobility, with a view to use this material as an absorber in solar cells. The transport parameter has been studied by measuring dc conductivity and Hall effect. The type of conduction has been measured by hot- probe method. Shallow and deep acceptor levels and grain boundary barrier heights were determined by measuring conductivity and Hall-voltage as a function of temperature in the range of 300-380K. Eleven samples were prepared of which height were studied for transport parameters and three were studied for stoichiometric composition. All the films are found to be p-type. The conductivity of the film at room temperature increases gradually as the annealing temperature and duration increase from 250˚C to 350˚C and from 5 to 20 minutes, respectively. Beyond that annealing temperature (> 350^{0}C) and duration (> 20 min), the conductivity drops. All film shows good compound formation. Such films can be used as base material for fabrication of solar cells and hence its composition and transport properties need to be known.

1.3 Analysis of Optical Properties of ZnSe Thin Film using Thermal Evaporation Technique

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

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

1.4 Deposition and Characterization of SnS thin Films by Spin Coating Deposition Technique (CBD)

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

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

Current progress: Tin di-sulfide (SnS_2) thin films were synthesized by Spin coating method. SnS thin films are deposited on glass substrate. Thin films were prepared at room temperature for 1500 rpm/30sec & annealing temperature A_T = 100^{0}C for 15 min. Annealing temperature significantly influenced crystallinity and surface roughness of the thin films in spin coating method. These films may be a good candidate for suitable application in various optoelectronic devices. Analysis of the parameters is going on.

1.5 Preparation and Characterization of the Structural, Optical, Morphological Characterization of SnS_2 Thin Films Deposited by Spin Coating Method

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

SnS_2 thin films with constant speed and different deposition time were prepared by simple and relatively easy spin coating method. Stanic cloride pentahydrate ($Cl_4H_{10}O_5Sn$), Thioacetamide were used as the precursors whereas Amonium cloride, Distilled water and Triethyleamine worked as solvent and stabilizer respectively. Solutions of all the samples were prepared using chemical bath deposition method. All the samples prepared at 1000, 1500 and 2000 rpm spin speed with varied deposition time such as 60s, 90s and 120s were annealed at room temperature for 1 hour. The thicknesses of all samples were measured and were found near 114 nm. The optical parameters such as transmittance, absorption coefficient and energy band gap of the films were investigated by UV-VIS-NIR. The optical measurement of transmittance, absorbance and band gap of these films were determined over 310nm to 2500nm using UV-Vis Spectrometry at room temperature. These films can be used as one of the important components for solar cell and electronic applications. Measurement and Analysis of the parameters are going on.

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

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

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

1.7 Study of the Theoretical Analysis of Structural, Electrical and Optical Properties of CdSxSe(1-x) (x=0, 0.25, 0.50, 1.0) Solid Solution by First Principle Calculation

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

The structural optical, elemental, and optical information were investigated by X-ray Diffraction (XRD), UV-VIS-NIR spectroscopy, respectively. In this research CdSxSe(1-x) 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, environmental sensors, biological sensors etc. Analysis of the parameters is going on.

1.8 Study of The Theoretical Analysis of Structural, Electrical and Optical Properties $BaTiO_3$ Theoretical Analysis by First Principle Calculation

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

Lattice dynamics, structural phase transition, and the thermodynamic properties of Barium Titanate ($BaTiO_3$) are investigated by using first-principles calculations within the density functional theory (DFT). It is found that the GGA-WC exchange-correlation functional can produce better results. On the basis of the site-symmetry consideration and group theory, we give the comparative phonon symmetry analysis in four phases, which is useful to analyze the role of different atomic displacements in the vibration modes of different symmetry. The calculated optical phonon frequencies at point for the four phases are in good agreement with other theoretical and experimental data. Analysis of the parameters is going on.

1.9 **Analysis of Structural, Optical** and **Electrical Properties** of CdTe **Thin Film**

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

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.

1.10 Study of Structural Optical and Latiice Dynamic Parameters of $Ba_xSr_{1-x}TiO_3$(x=1.0, 0.5, 0.0)

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

First Principle Calculations are performed to explore the structural, electrical and optical properties of $Ba_xSr_{1-x}TiO_3$(x=1.0, 0.5,0.0) using Density functional theory (DFT) within the Tran-Blaha modified Becke-Johnson (mBJ) approximation and generalized gradient approximation (GGA) as implemented in wien2k and Quantum ESPRESSO. The mBJ gives improved band gaps compared to GGA.The calculated band gap of BaTiO3, Ba0.5Sr0.5TiO3 and $SrTiO_3$ within mBJ exchange correlation are 2.6, 2.7 and 2.8 respectively. Density Functional Perturbation Theory (DFT) is employed to calculate the lattice dynamics. Negative frequencies are performed in the phonon dispersion spectra of all three perovskites indicating that the phases in questions are dynamically unstable.

1.11 To Observe The CdS Thin Film and Measure The Parameters of This Sample using Chemical Bath Deposition (CBD) Technique

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

The structural and optical properties of CBD deposited CdS thin films have been studied by varying the processing parameters and Cd/S ratio of the starting Precursors in order to better understand the growth conditions. A CdS thin film was prepared on glass substrate by CBD from a bath containing Thiourea and Ammonium hydroxide. The structural analysis was performed by XRD. The deposited CdS thin film was a cubic phase with small nano crystalline grains. The film was deposited at 60° C for 2 hours. After sintering the film at 300°C for 1 hour the color of the film was changed like dark yellowish and the thickness of the film was obtained 100 nm. These studies have allowed us to establish a standard set of conditions for the fabrication of homogeneous and continuous very thin CdS films in laboratory. One research article is published on this work.

1.12 Effect of the Annealing Temperature on CdS Nano Particles Synthesized by Chemical Precipitation Technique and also Characterized for Its Potential Technological Applications

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

Cadmium Sulfide (CdS) nano particles are synthesized by chemical precipitation method. Cadmium Chloride and Thiourea are used as the precursor materials. Ammonia water & distilled water are used as solvent. The samples are annealed at 100°C, 300°C and 500°C for 1 hour. Transmission electron microscopy (TEM), Energy–dispersive X-ray spectroscopy (EDAX), and X-ray diffraction pattern (XRD) are used to study the morphologies, distribution, and crystallinity of the CdS nano particles and to calculate the values of their sizes. The results indicate that the CdS are formed with Hexagonal structure and the particle size varies with the Cd^{+2} ions. Synthesized nano particles show structural properties after annealing. The particles are in high degree of crystallization. The XRD results reveal that the annealing effect has increased the crystalline size of the CdS nanoparticles.TEM demonstrates that the average sizes of spherical cadmium sulfide nano particles are 73.30 nm, 61.91nm and 88.81 nm at annealing temperature of 100°C, 300°C and 500°C respectively. In this research CdS has been studied due to its potential technological applications infield effect transistors, solar cells, photovoltaic devices, light emitting diodes, photo catalysis, photoluminescence, infrared photo detector, environmental sensors, biological sensors etc. One research article is published on this work.

1.13 To Observe The SnS_2 Thin Films and also Measure The Parameters of The Samples

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

Tin di-sulfide (SnS_2) thin films were synthesized by chemical precipitation method. SnS_2 thin films are deposited on glass substrate. Thin films were prepared at room temperature for 5 hours. & annealing temperature $A_T = 100^0$C for 60 min. Annealing temperature significantly influenced crystallinity and surface roughness of the thin films in CBD method. These films may be a good candidate for suitable application in various optoelectronic devices. Analysis of the parameters is going on.

1.14 Biosynthesis of Silver Nano Particle using Cell Based Chip

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

- AgNP formation mammalian cell cultred in AgNo3 supllemented growth medium
- Physical investigation and elemental confirmation of the synthesized AgNP
- Evaluation of the antibacterial activity of synthesized AgNP at the laboratory level as well as small scale field levels.

The proposed programme will develop a new antimicrobial agent capable of combating the recently focused Antimicrobial resistance (AMR) issue. This will be achieved with the intracellular formation of AgNp using biocompatible materials and eco-friendly processes and hence comply with the green technology. The developed AgNP will be used as an antimicrobial agent instead of the currently practiced antibiotics, thereby overcoming the AMR issues. Besides, the proposed green fabrication process of the intracellular formed AgNP is ensuring their host compatibility.

1.15 Analysis of Structural, Optical, Elemental and Electrical Properties of Mn doped ZnSe Thin Films

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

1%, 1.5%, 2%, 2.5% Mn doped ZnSe Thin film were prepared by thermal evaporation technique. ZnSe thin films of thickness 500 nm & substrate temperature S_T = 250^{0}C and annealing temperature A_T =230^{0}C with annealing time 1 hour is prepared by thermal evaporation method. Optical properties were characterized by UV-VIS-NIR spectroscopy. The most important parameter optical band gap estimated on this research work. Structural parameters such as crystallite size, stress, strain, dislocation density was obtained from the XRD data using different models. Elemental measurement was observed by FTIR. ZnSe films thickness were calculated and synthesis and Analysis of the parameters are going on.

1.16 Analysis of Structural, Optical, Elemental and Electrical Properties of CuO Thin Films

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

1.5972g copper acetate was added in 40mL isupropanol to prepare 0.2M solution. Solution was stirred for 15 min at rom temparature (22^o C). Then 20mL MEA was added to the solution to Stabilize. Furthermore, the solution was stirred for 45 min at 70^{o}C. Then a ready glass substrate was dipped in to the solution for 1 hour at 70^{o}C. After that the substrates was annealed for 15 min at 100^{o}C.

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

Name of the participant	Title of the event	Organizer	Date	Place
Dr. K. M. A. Hussain	International Conference on Physics- 2022	BPS	19-21 May 2022	AECD
	International Conference on Electronics-2021	ICEI	27-28 Nov. 2021	AECD
M. S. S. Chowdhury	International Conference on Physics- 2022	BPS	19-21 May 2022	AECD
T. Faruqe	International Conference on Electronics - 2021	ICEI	27-28 Nov. 2021	AECD
	International Conference on Physics- 2022	BPS	19-21 May 2022	AECD
J. Parvin	International Conference on Electronics - 2021	ICEI	27-28 Nov. 2021	AECD
	International Conference on Physics - 2022	BPS	19-21 May 2022	AECD
F. T. Z. Toma	International Conference on Electronics - 2021	ICEI	27-28 Nov. 2021	AECD
	International Conference on Physics -2022	BPS	19-21 May 2022	AECD

3. Collaboration Work(s)

3.1 Project Work (Ministry of Science and Technology)

"Modernization of laboratories and Enhancement of Service Capacity of 3 Divisions (Chemistry Division, Health Physics Division, Experimental Physics Division) of Atomic Energy Center, Dhaka. Bangladesh Atomic Energy Commission", Project year: 2021-24, Office order no-39.00.0000.014.14.057-21-255; Date: 13-12-2021, Grant amount: 4498.00 Lack Taka) only, Project Director: Dr. Kazi Md. Amjad Hussain, Head and Chief Scientific Officer, Experimental Physics Division, Atomic Energy Centre, Dhaka.

3.2 Others

Collaboration with teachers and research students of

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

3.3 Repair and Maintenance Work(s)

- **NIRVAT High Vacuum Coating System**

The Pirani gauge measures the vacuum pressure dependent thermal conductivity from the heated wire to the surrounding gas. In this system pirani gauage meter does not work properly because of the pin of pirani gauge connection head which is currently unable to work that's why this pirani gauage system is not used in vacuum systems to measure low pressures.

- **Edward Coating System**

The connection part of the substrate heater is disconnected while the evaporation system is in operation and when this problem occurred all the materials is dropped down. For this reason sample preparation is not possible in this situation.

Health Physics Division, AECD

Objective(s)

The objective of this division is to protect life, property and environment from undue radiation hazard through: (i) Population exposure control (ii) Occupational exposure control (iii) Medical exposure control and (iv) Radiation protection services. Radiation and radioactivity in environmental samples and imported/ exportable foods (except Chittagong Port) are being monitored as per requirement of the NSRC rules 1997 and BAER Act-2012. This division is the only 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.

Programme(s)

Environmental Radiation and Radioactivity Monitoring

- Measurement of background radiation levels throughout Bangladesh and assessment of population exposure
- Analysis of different radionuclides in environmental and biological samples both qualitatively and quantitatively
- Development and standardization of analytical methods for low level measurement of radioactivity in environmental samples

- Measurement of environmental gamma dose by Thermo-luminescent Dosimeter
- Estimation of radioactivity concentration in Naturally Occurring Radioactive Materials samples of different gas fields
- Measurement of environmental gamma doses by In-Situ method
- Assessment of Gross Alpha and Gross Beta activity in environmental samples
- Determination of the Radon concentration in environmental samples such as air, water and soil

Occupational Exposure Control

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

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 Programme for Radioactivity Measurement

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

Quality Assurance Programme of Individual Monitoring System

- Performance test of TL Dosimeter system through routine test and calibration
- Participation in the inter comparison programme 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, N. Sultana, F. Kabir, Z. Hossain and A. Joydhar

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

Current progress: During this reporting period, measurement of background radiation level has been carried out regularly in and around Dhaka city on monthly basis as a part of this work. In this study, Gamma Scout (w/Alert, Digital Survey meter) was used with Global Positioning System (GPS) for pointing the location. The average background radiation level was found from (0.13 to 0.25) μSvh^{-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, N. Sultana, F. Kabir,Z. Hossain and A. Joydhar

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

Current progress: Five divisions of AECD, viz. Non-Destructive Testing (NDT), Accelerator Facilities Division (AFD), Material Science Division (MSD), Chemistry Division and Health Physics Division (HPD) of AECD have been using radioisotopes and radiation producing equipments for research & development works. Radiation monitoring has been done on monthly basis in and around the above-mentioned divisions by using Gamma Scout (w/Alert, Digital Survey meter). The radiation levels in front of isotope storeroom (corridor) of HPD, Source room (corridor) of HPD, NDT Source storeroom and in front of door of NDT source room were found (0.50 - 2.13) μSvh^{-1}, (0.22 – 0.41) μSvh^{-1}, (0.51 – 4.35) μSvh^{-1} and (0.21-0.39) μSvh^{-}

[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, N. Sultana, F. Kabir, Z. Hossain and A. Joydhar

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

Current progress: During the reporting period, sixteen rain water samples were collected from AECD campus Dhaka, Tongi, Mohammadpur and Mirpur area. The activity concentration of natural radionuclides ^{238}U, ^{232}Th, and ^{40}K were determined by Gamma Spectrometry System consists of High Purity Germanium (HPGe) detector coupled with a digital spectrum analyzer (DSP^{ec}jr 2.0). The radioactivity range of ^{238}U series, ^{232}Th series and ^{40}K was within the acceptable limit. Artificial radionuclide was not found.

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

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

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

Current Progress: Total 75 (Thirty-five) imported food samples were collected from different local markets in Mirpur, Dhaka. Different Food samples such as Anchor Beans, Dabli, Ginger, Garlic, Rice, Red Wheat, White Wheat, Lentils, Chhola, Palm Oil and Soybean oil were imported from different countries such as Australia, China, India, Pakistan, Maldives, Malaysia and Nepal. The samples were processed following the standard procedures provided by IAEA and analyzed for gamma emitting radionuclides. The radioactivity range of ^{238}U series, ^{232}Th series and ^{40}K was within the acceptable limit. Artificial radionuclide was not observed.

1.5 Assessment of Radioactivity in Soil and Sediment Samples Collected from Buriganga and Turag River in Bangladesh

T. Chowdhury*, M. M. M. Siraz, M. S. Islam* and S. Yeasmin

Objective: To provide a safe and secure environment around Buriganga and Turag River, it is vital to monitor the level of radiation and radioactivity in the environment around Buriganga and Turag River

Current progress: High Purity Germanium (HPGe) Detector was used to determine the radioactivity of total 39 soil and sediment samples [10 soil samples and 10 sediment samples from the Buriganga river, 10 sediment samples and 9 soil samples from the Turag River] collected from the rivers. Presence of ^{232}Th, ^{40}K, ^{226}Ra were found at the samples but none of those exceeded the worldwide average values of activity concentration. Ranges of the elements were found as following: ^{232}Th: 20 Bq/kg to 51 Bq/kg (mean 31.06 Bq/kg), ^{40}K: 138 Bq/kg to 430 Bq/kg (mean 278.72 Bq/kg), ^{226}Ra: 11.1 Bq/kg to 45 Bq/kg (mean 15.83 Bq/kg). The average value of Radium Equivalent Activity (Ra_{eq}), Outdoora Absorbed Dose rate (D_{out}), Indoor Absorbed Dose rate (Din), External Hazard Index (H_{ex}), Internal Hazard Index (H_{in}), External Effective Dose (E_{out}), Internal Effective Dose (E_{in}) and Annual Effective Dose (E) are 86.52 Bq/Kg, 41.191nGy/h, 49.43 nGy/h, 0.23 nGy/h, 0.29 nGy/h, 0.05 mSv/y, 0.24 mSv/y, 0.29 mSv/y respectively. Also, all the resulted values found from this study were well below the required safe limits.

*Department of Nuclear Engineering, University of Dhaka

1.6 Assessment of Radioactivity and Radiological Hazard in Soil and Water Sample collected from Bhola 225 MW Combined Cycle Power Plant, Borhanuddin, Bhola, Bangladesh

M. Sarker*, M. M.M. Siraz, M. J. Dewan* and S. Yeasmin

Objective: To monitor the level of radioactivity in Soil and Water Sample collected from Bhola 225 MW Combined Cycle Power Plant

Current Progress: In this study, the activity concentrations of 226Ra, 232Th and 40K in 23 samples (20 soil samples, 3 water samples) collected around Bhola 225 MW CCPP were measured by gamma-ray

spectroscopy system using High purity Germanium (HPGe) detector with 30% relative efficiency. The average activity concentration of ^{226}Ra, ^{232}Th and, ^{40}K of soil samples were 28.33±3.2, 41.55±5, 443.95±31.29 Bqkg^{-1} respectively. Mean value of radium equivalent activity of these soil samples was found to be 127.54 Bqkg^{-1}. Average internal & external hazard index were found to be 0.41 and 0.33. Annual effective dose of these soil samples was found to be 0.42 mSvy^{-1}. The results were compared with national and international safety guides and regulations and they were found within recommended safety limits. The results of this study will be used as baseline database around Bhola 225 MW CCPP for radiological protection of people.

*Department of Nuclear Engineering, University of Dhaka

1.7 Measurement of Radioactivity in Soil Samples Collected around Savar, Narayanganj and Dhamrai in Bangladesh

M. D. A. Rakib*, M. M. M. Siraz, M. S. Islam* and S. Yeasmin

Objective: The study was conducted to measure the radioactivity level and to assess the risk of health hazards due to radiation.

Current progress: Activity concentrations of radionuclides in thirty-five soil samples collected from Savar, Narayanganj and Dhamrai, of Bangladesh were measured by Gamma-ray spectrometry using an HPGe detector. The activity concentrations of ^{226}Ra, ^{232}Th and ^{40}K in soil samples varied from 22.5 ± 2.92 to 79 ± 8.69 Bq/kg, 33 ± 4.95 to 47 ± 6.11Bq/kg and 310 ± 31 to 430 ± 38.7 Bq/kg respectively, with a mean of 31.27 ± 3.82 Bq/kg, 39.66 ± 4.99 Bq/kg and 356.57 ± 36.34 Bq/kg respectively. The potential radiological hazard was assessed by calculating internal and external hazard indices, radium equivalent activity, absorbed dose rate and annual effective dose associated with the soil samples and all the obtained values were below the recommended safety limits.

*Department of Nuclear Engineering, University of Dhaka

1.8 Background Radiation Survey and Measurement of Radioactivity and Radiological Hazards in Soil Samples Collected around Dhaka City

T. A. Alif*, M. M. M. Siraz, M. J. Dewan* and S.Yeasmin

Objective: The main purpose of the study is to determine if the general population is safe from radiation health hazards when they travel around the hospitals of Dhaka city.

Current progress: The soil samples were analyzed from 25 locations around Dhaka city for the activity concentration of natural radionuclides in them by gamma ray spectrometry using HPGe detector. The activity concentrations of ^{226}Ra in the soil samples have varied from 14 ± 2.1 Bq/kg to 41 ± 4.92 Bq/kg, ^{232}Th in the soil samples have varied from 25 ± 3.75 Bq/kg to 46.0 ± 5.52 Bq/kg and ^{40}K in the soil samples have varied from 209.0 ± 27.17 Bq/kg to 350.0 ± 35 Bq/kg respectively. The average values of radium equivalent activity in all samples are 92.44 Bq/kg. The minimum and maximum values of radium equivalent activity are 70.36 Bqkg-1 and 119.87 Bq/kg respectively, those are far below the allowable limit (370 Bq/kg) as recommended by the IAEA. The average value of internal & external hazard index is 0.28 & 0.35 respectively which less than unity in all the samples that indicate the non-hazardous for human being. The total annual effective dose rate associated with all samples in this study ranged from 0.23 mSvy^{-1} to 0.40 mSvy^{-1} with a mean of 0.31 mSvy^{-1}, which is less than 1 mSvy^{-1} that indicates the non-hazardous for human being.

*Department of Nuclear Engineering, University of Dhaka

1.9 Assessment of Radioactivity and Radiological Hazard in Soil Sample collected from Bandarban, Bangladesh

D. Roy*, M. M. M. Siraz, M. J. Dewan* and S.Yeasmin

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

Current Progress: High purity germanium (HPGe) detector was used for gamma-ray spectrometry using to assess the radioactivity in 24 soil samples obtained from the Upazilla of Bandarban, Bangladesh. The specific activity of the soil samples ranged from 15.8 ± 1.74 Bqkg^{-1} to 24.6 ± 2.46 Bqkg^{-1} for ^{226}Ra, from 29 ± 3.19 to 40 ± 4 Bqkg^{-1} for ^{232}Th, and from 271 ± 18.97 Bqkg^{-1} to 413 ± 24.78 Bqkg^{-1} for ^{40}K. The Radium Equivalent activities of soil samples varied from 78.14 Bqkg^{-1} to 110.56 Bqkg^{-1} with an average value of 101.52 Bqkg^{-1}. The outdoor absorbed dose rate (D_{out}) ranged from 37.65 nGyh^{-1} to 53.19 nGyh^{-1}. The indoor absorbed dose

rate (D_{in}) ranged from 45.18 $nGyh^{-1}$ to 63.82 $nGyh^{-1}$. For all the soil samples, both the external and internal hazard indexes are less than one. No artificial radionuclide was detectable in any of the samples. In this investigation, the total yearly effective dose (E) associated with soil samples ranged from 0.26 $mSvy^{-1}$ to 0.37$mSvy^{-1}$, with a mean value of 0.34 $mSvy^{-1}$. The results were found to be within prescribed safety thresholds when compared to national and international safety standards.

*Department of Nuclear Engineering, University of Dhaka

1.10 Assessment of Radioactivity Concentration and Radiological Hazards in the Polluted Buriganga River Water and Tap Water of the Megacity Dhaka

M. S. Alam*, M. M. M. Siraz, A. Shelley* and S. Yeasmin

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

Current progress: In this study, 30 samples including 10 tap water samples collected from different localities of Dhaka city and 20 samples from various locations of the Buriganga river. The activity concentration in tap water varied between 0.55 Bq/L and 3.06 Bq/L, with a mean of 1.53 Bq/L, and in river water, it had a mean of 0.67 Bq/L and varied from 0.34 Bq/L to 1.160 Bq/L. The mean values of the total annual effective doses due to inhalation and ingestion were measured to be 3.93 µSv/y and 1.72 µSv/y for tap water and river water, respectively. All these values were well below the permissible limit proposed by the WHO.

*Department of Nuclear Engineering, University of Dhaka

1.11 Measurement of Radioactivity Concentration in Commercially Available Bottled Water and Evaluation of the Associated Effective Dose

J. A. Mahmud*, M. M. M. Siraz, A. Shelley* and S. Yeasmin

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

Current progress: Twenty samples of commercially available bottled water from the markets of Dhaka, Bangladesh were analyzed. The radioactivity concentration in the bottled water ranged from 0.10 Bq/L to 1.30 Bq/L with a mean of 0.59 Bq/L. The total effective dose due to inhalation and ingestion from bottled water were evaluated and found to be in the range of 0.02 µSv/y to 0.27 µSv/y with a mean of 0.12 µSv/y. All the effective doses given by bottled water were below the recommended limit proposed by WHO and UNSCEAR. Thus, the consumption of bottled water is safe for drinking in terms of radioactivity concentration.

*Department of Nuclear Engineering, University of Dhaka

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

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

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

Current progress: To prepare baseline data of environmental background radiation around the Rooppur Nuclear Power Plant (RNPP) site, total 96 environmental samples (Surface water 44, sand and sediment-11, rain water-08, aquatic vegetation-05, air particle-08, for radon measurement -20 surface water) were collected from the 32 km radial distance of RNPP. All samples were processed following the standard procedures as International Atomic Energy Agency (IAEA) guidelines. After preparation, samples will be measured by using high-purity germanium (HPGe) detector with relative efficiency of 30%. The work is in progress.

1.13 A Study of Natural Radionuclide Concentrations in Soil and Water Samples at Banshkhali Upazilla in Chittagong District, Bangladesh

M. J. Farid*, S. Pervin , M. M. H. Miah*, S. Banik, N. Sultana, M. F. Kabir, A. Joydhar and S. Yeasmin

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

Current Progress: The activity concentrations of naturally occurring radionuclides ^{238}U, ^{232}Th and ^{40}K in soil and water samples was measured at Banshkhali upazilla in Chittagong using High Purity Germanium (HPGe) detector. The activity concentrations of radionuclides ^{238}U, ^{232}Th and ^{40}K in soil samples ranged from 0.29 to

18.10 Bq/kg, 2.07 to 27.77 Bq/kg and 3.98to 143.93 Bq/kg respectively and in water samples 0.12 to 1.60 Bq/kg , 0.99to 2.80 Bq/kg and 9.558 to82.89 Bq/kg respectively. The results have been compared with national and international safety standards and they were found within recommended safety limits.

[*] Department of Physics, University of Chittagong.

1.14 Measurement of Natural and Artificial Radioactivity and Radiological Hazard of Different Raw Milk Samples Collected from Different Locations of Dhaka City using Gamma Ray Spectrometry System

M. M. Kabir, S. Pervin, M. J. Dewan*, S. Banik, N. Sultana, M. F. Kabir, A. Joydhar and S. Yeasmin

Objective: To determine the natural radionuclides and their activity concentration in 11 raw milk samples.

Current Progress: The activity concentrations of naturally occurring radionuclides ^{238}U, ^{232}Th and ^{40}K in 11 raw milk samples was measured Collected from Different Locations of Dhaka City Using Gamma Ray Spectrometry System. The mean activity concentrations of ^{238}U, ^{232}Th and ^{40}K in cements samples were found to be varied from 4.26±0.16 to 15.12±4.15 Bq/kg with an average of 8.593±4.19 Bq/kg, 2.38±0.04 to 12.36±4.57 Bq/kg with an average of 7.81±3.14 Bq/kg and 86±20 to 230±28.72 Bq/kg with an average of 161.09±27.25 Bq/kg respectively. No ^{137}Cs was found during the measurement as it is an artificial radionuclide. The calculated average value is lower than the world average limit. The values of activity concentration were compared to the values around the world and similarities were found between the values.

*Department of Nuclear Engineering, University of Dhaka

1.15 Study of Environmental Radiation and Radioactivity on Sand Samples and Associate Health Hazards Collected from Different Locations of Gorai-Modhumoti River Near Rooppur Nuclear Power Plant using Gamma-ray Spectrometry System

M. J. Ali[*], S. Pervin, A. Pal[*], S. Banik, N. Sultana, M. F. Kabir, A. Joydhar and S. Yeasmin

Objective: To measure the radioactivity and assess the radiological hazard associated with sand Samples.

Current progress: The activity concentration of ^{238}U, ^{232}Th and ^{40}K of sand samples from Gorai River, is measured by High purity Germanium Detector. The activity concentration of ^{238}U, ^{232}Th and ^{40}K of sand samples are ranged from 10±5.72 Bq/kg to 29±4.58 Bq/kg with a mean value of 20.16±5.86 Bq/kg, and 8.27±6.78 Bq/kg to 28±8.73 Bq/kg and mean value of 17.45±6.30, and 105±32 Bq/kg to 325±48.88 Bq/kg with a mean value of 224.58±34.77 Bq/kg. Absorbed doses are found to be varied from 14.74 nGy/hr to 40 nGy/hr, and the mean value of these samples is 29.29 nGy/hr. The average indoor and outdoor Annual Effective doses are 0.14 mSv and 0.03 mSv. The internal hazard index (H_{in}) is found to be varied from 0.11 to 0.30, and the average value is 0.22. External hazard index (H_{ex}) is found to be varied from 0.08 to 0.22, and the average value is 0.17 Radium (Ra_{eq}) equivalent activity is found to be varied from 31.58 Bq/kg to 84.86 Bq/kg, and the average is 62.41 Bq/kg. No artificial radionuclide (^{137}Cs) has not been found in this study. All hazard parameters remain in acceptable values below the average world values.

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

1.16 Determination of Radioactivity Concentration, Transfer Factor from Soil to Rice of Jessore District, Bangladesh and Associated Health Hazards Assessment

L. Lubna[*], S. Pervin, M. I. Hosan[*], S. Banik, N. Sultana, M. F. Kabir, A. Joydhar and S. Yeasmin

Objective: To measure the radioactivity and assess the radiological hazard associated with sand Samples.

Current progress: The activity concentration of natural radionuclides in 15 soil samples and 15 rice samples and 15 rice samples was measured collected from three different thanas of Jashore district by gamma ray spectrometry system using High Purity Germanium (HPGe) detector. For soil, the average activity concentrations of ^{226}Ra, ^{232}Th, and ^{40}K were found to be 31±18 Bq/kg, 32±20 Bq/kg and 390±23 Bq/kg respectively which were less than the world average value. For rice, the values were found 10±2 Bq/kg, 16±7.5 Bq/kg and 380±14.7 Bq/kg respectively. For ^{226}Ra, average value of Transfer factor was 0.54. For ^{232}Th, average value of Transfer factor was 0.30. For ^{40}K, average value of Transfer factor was 0.70. The average value of absorbed dose in soil 55 (nGy/h) which is less than the world average. The average value of absorbed dose in rice was 46 (nGy/h).The average value of Radium Equivalent Activity of soil was 156 Bq/kg which is below the world average. The average value of Radium Equivalent Activity of rice was 62 Bq/kg.

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

1.17 Study on Outdoor Environmental Gamma Radiationof Tejgaon Thana by In-Situ Method

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

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

Current Progress: In-Situ Environmental gamma-ray dose rate was measured at 32 locations of Tejgaon Thana under Dhaka district using real-time environmental radiation measuring device (GAMMA-SCOUT GmbH & Co. KG). This device meets all European CE standards as well as the American "FCC 15 standard". All the locations were marked out using global positioning system (GPS). The dose rate varied from 0.085-0.190µSv/h with an average of 0.145µSv/h. The annual effective dose of the population due to the environmental gamma radiation was also calculated and it was varied from 0.104–0.233 mSv.

*Department of Physics, Jahangirnagar University

1.18 Study on Indoor and Outdoor Gamma Radiation of INMAS Mitford Hospital Campus by In-Situ Method

M. S. Rahman, L. A. Tonu*, S. Yeasmin, M. M. M. Siraz, S. Pervin, S. Banik, N. Sultana, F. Kabir, 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 departments 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- 4.31µSv/h with an average of 0.456µSv/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.

*Department of Physics, Pabna Science and Technology University

1.19 Study on Indoor and Outdoor Environmental Radiation of DMCH by In-Situ Method

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

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

Current Progress: In-Situ Environmental gamma-ray dose rate was measured at 32 locations of DMCH campus using real-time environmental radiation measuring device (GAMMA-SCOUT GmbH & Co. KG). This device meets all European CE standards as well as the American "FCC 15 standard". All the locations were marked out using global positioning system (GPS). The dose rate varied from 0.095-0.580µSv/h with an average of 0.147µSv/h. The annual effective dose of the population due to the environmental gamma radiation was also calculated and it was varied from 0.832–1.621 mSv.

*Department of Environmental Sciences, Jahangirnagar University

1.20 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, N. Sultana, F. Kabir, 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 departments 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- 3.518µSv/h with an

average of 1.054μSv/h. The annual effective dose of the population due to the outdoor gamma radiation was also calculated and it was varied from 0.279–5.514 mSv.

*Department of Environmental Sciences, Jahangirnagar University

1.21 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, N. Sultana, F. Kabir, Z. Hossain and K. N. Sakib*

Objective: To measure the indoor radiation of AECD Campus from natural and artficial 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.

*Department of Physics, Mawlana Bhashani Science and Technology University

1.22 Study on Outdoor Environmental Gamma Radiation of Dhanmondi Thana by In-Situ Method

M. S. Rahman, E. Z. Lucy*, S. Yeasmin, M. M. M. Siraz, S. Pervin, S. Banik, N. Sultana, F. Kabir, Z. Hossain, K. N. Sakib*

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

Current Progress: In-Situ Environmental gamma-ray dose rate was measured at 32 locations of Dhanmondi Thana using real-time environmental radiation measuring device (GAMMA-SCOUT GmbH & Co. KG). This device meets all European CE standards as well as the American "FCC 15 standard". All the locations were marked out using global positioning system (GPS). The dose rate varied from 0.086-0.197μSv/h with an average of 0.147 μSv/h. The annual effective dose of the population due to the environmental gamma radiation was also calculated and it was varied from 0.832–1.621 mSv.

*Department of Physics, Mawlana Bhashani Science and Technology University

1.23 Continuous Radiation Monitoring at Indoor Places of AECD Campus usingThermoluminescent Dosimeter

M. S. Rahman, M. Ashraf*, S. Yeasmin, M. M. M. Siraz, S. Pervin, S. Banik, N. Sultana, F. Kabir, Z. Hossain and M. K. U. Sikder*

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.

*Department of Physics, Jahangirnagar University

1.24 Study on Indoor Radiation of AECD Campus using Thermoluminescent Dosimeter

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

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 tomeasure 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.

*Department of Physics, Jahangirnagar University

1.25 Study on Outdoor Radiation of BSMMU Hospital Campus by In-Situ method

M. S. Rahman, A. Tareque*, S. Yeasmin, M. M. M. Siraz, S. Pervin, S. Banik, N. Sultana, F. Kabir, Z. Hossain and S. 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 departments 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 outdoor radiation dose rate varied from 0.181- 3.123μSv/h with an average of 1.012μSv/h. The annual effective dose of the population due to the indoor gamma radiation was also calculated and it was varied from 0.234–4.921 mSv.

*Department of Physics, Jagannath University

1.26 Study on Outdoor Radiation of Evercare & United Hospital Campuses by In-Situ Method

M. S. Rahman, S. Akter*, S. Yeasmin, M. M. M. Siraz, S. Pervin, S. Banik, N. Sultana, F. Kabir, Z. Hossain and K. N. Sakib*

Objective: Nuclear medicine workers usually handle radioactive sources during preparation and administering. So, there is a possibility to receive higher doses during their daily work. Therefore, it is required to measure real-time gamma radiation dose rate in nuclear medicine departments in order to ensure safe working environment of workers.

Current Progress: In-Situ outdoor radiation was measured at 64 locations of Evercare & United Hospitals Campuses using real-time gamma radiation measuring device (GAMMA-SCOUT GmbH & Co. KG). This device meets all European CE standards as well as the American "FCC 15 standard". All the locations were marked out using global positioning system (GPS). The outdoor radiation dose rate varied from 0.120- 1.812 μSv/h with an average of 4.124 μSv/h. The annual effective dose of the population due to the indoor gamma radiation was also calculated and it was varied from 0.131–1.243 mSv.

*Department of Physics, Mawlana Bhashani Science and Technology University

1.27 Study on Outdoor Radiation of Square Hospital & National Heart Foundation Campuses by In-Situ Method

M. S. Rahman, S. S. Mitu*, S. Yeasmin, M. M. M. Siraz, S. Pervin, S. Banik, N. Sultana, F. Kabir, Z. Hossain and K. N. Sakib*

Objective: Nuclear medicine workers usually handle radioactive sources during preparation and administering. So, there is a possibility to receive higher doses during their daily work. Therefore, it is required to measure real-time gamma radiation dose rate in nuclear medicine departments in order to ensure safe working environment of workers.

Current Progress: In-Situ indoor radiation was measured at 64 locations of Square Hospital & National Heart Foundation Campuses using real-time gamma radiation measuring device (GAMMA-SCOUT GmbH & Co. KG). This device meets all European CE standards as well as the American "FCC 15 standard". All the locations were marked out using global positioning system (GPS). The outdoor radiation dose rate varied from 0.102- 0.821μSv/h with an average of 0.271μSv/h. The annual effective dose of the population due to the indoor gamma radiation was also calculated and it was varied from 0.431–2.514 mSv.

*Department of Physics, Mawlana Bhashani Science and Technology University

1.28 Study on Outdoor Radiation of Lab Aid and Suhrawardy Medical College Hospitals by In-Situ Method

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

Objective: Nuclear medicine workers usually handle radioactive sources during preparation and administering. So, there is a possibility to receive higher doses during their daily work. Therefore, it is

required to measure real-time gamma radiation dose rate in nuclear medicine departments in order to ensure safe working environment of workers.

Current Progress: In-Situ indoor radiation was measured at 64 locations of Lab Aid & Suhrawardy Hospital Campuses using real-time gamma radiation measuring device (GAMMA-SCOUT GmbH & Co. KG). This device meets all European CE standards as well as the American "FCC 15 standard". All the locations were marked out using global positioning system (GPS). The outdoor radiation dose rate varied from 0.152- 3.232 µSv/h with an average of 0.472µSv/h. The annual effective dose of the population due to the indoor gamma radiation was also calculated and it was varied from 0.432–7.514 mSv.

*Department of Physics, Jahangirnagar University

1.29 Study on Outdoor Radiation of Three Large Hospitals in Dhaka by In-Situ Method

M. S. Rahman, M. Mustafiz*, S. Yeasmin, M. M. M. Siraz, S. Pervin, S. Banik, N. Sultana, F. Kabir, Z. Hossain and M. R. Rahman*

Objective: Nuclear medicine workers usually handle radioactive sources during preparation and administering. So, there is a possibility to receive higher doses during their daily work. Therefore, it is required to measure real-time gamma radiation dose rate in nuclear medicine departments in order to ensure safe working environment of workers.

Current Progress: In-Situ indoor radiation was measured at 96 locations of BSMMU & DMCH and Mitford Hospitals Campuses using real-time gamma radiation measuring device (GAMMA-SCOUT GmbH & Co. KG). This device meets all European CE standards as well as the American "FCC 15 standard". All the locations were marked out using global positioning system (GPS). The outdoor radiation dose rate varied from 0.103- 3.145µSv/h with an average of 0.254µSv/h. The annual effective dose of the population due to the outdoor gamma radiation was also calculated and it was varied from 0.263–7.843 mSv.

*Physics Discipline, Khulna University

1.30 Study on Outdoor Radiation of Cancer Hospital in Dhaka by In-Situ Method

M. S. Rahman, M. Arman*, S. Yeasmin, M. M. M. Siraz, S. Pervin, S. Banik, N. Sultana, F. Kabir, Z. Hossain and M. K. U. Sikder*

Objective: Nuclear medicine workers usually handle radioactive sources during preparation and administering. So, there is a possibility to receive higher doses during their daily work. Therefore, it is required to measure real-time gamma radiation dose rate in nuclear medicine departments in order to ensure safe working environment of workers.

Current Progress: In-Situ 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 outdoor radiation dose rate varied from 0.123- 2.174µSv/h with an average of 0.354µSv/h. The annual effective dose of the population due to the outdoor gamma radiation was also calculated and it was varied from 0.246–7.342 mSv.

*Department of Physics, Jahangirnagar University

1.31 Study on Outdoor Radiation of BIRDEM Hospital in Dhaka by In-Situ Method

M. S. Rahman, M. Shakil*, S. Yeasmin, M. M. M. Siraz, S. Pervin, S. Banik, N. Sultana, F. Kabir, Z. Hossain and M. K. U. Sikder*

Objective: Nuclear medicine workers usually handle radioactive sources during preparation and administering. So, there is a possibility to receive higher doses during their daily work. Therefore, it is required tomeasure real-time gamma radiation dose rate in nuclear medicine departments in order to ensure safe working environment of workers.

Current Progress: In-Situ indoor radiation was measured at 32 locations of BIRDEM Hospital Campus using real-time gamma radiation measuring device (GAMMA-SCOUT GmbH & Co. KG). This device meets all European CE standards as well as the American "FCC 15 standard". All the locations were marked out using global positioning system (GPS). The outdoor radiation dose rate varied from 0.104- 2.034µSv/h with an

average of 0.365μSv/h. The annual effective dose of the population due to the outdoor gamma radiation was also calculated and it was varied from 0.354–6.702 mSv.

*Department of Physics, Jahangirnagar University

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

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

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

Current progress: To prepare baseline data of environmental background radiation around the Rooppur Nuclear Power Plant (RNPP) site, background gamma radiation monitoring was performed in the 32 km radial distances of RNPP. The equipment used for the measurement of radiation dose Level is Radiation Survey Meter (Gamma-Scout). The work is in progress.

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

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

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

Current progress: To prepare baseline data of environmental background radiation around the Rooppur Nuclear Power Plant (RNPP) site, total 92 samples (surface water = 44, bottom water = 14, sediment = 14, aquatic vegetation = 12 and air samples =8) were collected from the 32 km radial distance of RNPP. Among these samples 78 samples were processed following the standard procedures as International Atomic Energy Agency (IAEA) guidelines. After preparation samples will be measured by using high-purity germanium (HPGe) detector. The work is in progress.

1.34 Environmental Radiation Dose Monitoring around Dhaka University Campus and Estimation of Radiation Risk on Public Health

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

Objective: The object of this study is to determine the environmental and manmade radiation dose and evaluation excess lifetime cancer risk ELCR.

Current progress: During this reporting period, background dose rate has been monitored from 61 monitoring points. For this monitoring, digital portable radiation monitoring device (gamma scout sl no. 019842) used for radiation dose measurements and GARMIN eTRex^{10} series personal navigator used for location identification. During this particular monitoring, survey meter was placed at 1 meter above the ground. The measured dose rate differs from 0.067±0.02 – 0.19±0.01 μSv/h with a mean value of 0.138±0.003 μSv/h. The outdoor annual effective dose (AED) to the public was varied from 0.117±0.03 – 0.333±0.018 mSv/y with a mean of 0.24±0.02 mSv/y. From this study AED is less than 1 mSv/y which is the maximum acceptable limit of public exposure (ICRP,2007). ELCR on public health also calculated from these data and that varied from 0.48×10^{-3} – 1.37×10^{-3} with a mean value of 0.99×10^{-3}.

1.35 Environmental Radiation Surveillance by Using Thermoluminescent Dosimeter around AECD Campus

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

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

Current progress: The measurements were performed at different locations in the AECD campus, using TLD-100 (LiF: Mg, Ti) chip dosimeters were placed in the radiation monitoring post. There are 10 (ten) customized radiation monitoring posts each containing 5 (five chips) was placed 1m above the ground level (gonad height) in light-tight condition. The chips were collected to compare the seasonal variation by Thermo Scientific™ HARSHAW TLD™ Model 3500 Manual Reader. The result of the background measurements was also compared with the data of the digital beta/gamma survey meter. From this study, the result showed

average background radiation in this area is ~ 1.23 mSv/y. The absorbed dose of TLD-100 remained in good agreement (typically within ±5% but in some cases extending beyond this) with the results from survey meter data.

1.36 TL investigation of Smart Phone Glass Protectors as Fortuitous Dosimeters for Radiation Accident Dosimetry

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

Objective: Following a large-scale unexpected nuclear accident or radiological incident it is essential to estimate the absorbed dose of radiation received by the individuals to provide an emergency medical care. The aim of the present work is to investigate the radiation-induced TL signal and intrinsic background signal of glass from mobile phone screen protectors. The key TL dosimetric characteristics have also been studied, including glow curves, dose response, relative sensitivities with respect to standard TLD-100.

Current progress: This project uses thermoluminescence techniques to investigate the radiation dose history of materials suspected to have been exposed to man-made (artificial) radiation, from the perspective of retrospective dosimetry measurement. In the event of radiological accident, the conventional dedicated personal dosimetry data might be collapsed. Recently, research is underway for searching so-called 'fortuitous' materials with dosimetric properties that may be used to assess the absorbed dose of radiation possibly received by the victims. After investigated the glass samples seem promising for retrospective dosimetry purposes, having TL responses, proper glow curve peaks and the intensity of TL peaks vs. temperature received provided nearly linear response in the dose range of 0.5 Gy to 8.0 Gy. Some of the glasses have been found to be sensitive enough that they can be used as TL dating material in radiological accident situation for gamma dosimetry with lower detection limit 0.5 Gy. At high dose (8.0 Gy), the glass samples show relatively better response. The general structure of the glow curves remain unchanged at various doses that are well above 250°C in some cases may beyond 300°C, be a sign of high thermal stability of TL response of the samples with deep trapping centers. Obtained TL yield indicate studied samples are convenient for retrospective dosimetry dose reconstruction.

1.37 Thermoluminescence Property Changes with Different Doping Material in Zinc, Lithium and Calcium

A. K. M. M. Rahman, A. Mimi*, M. R. Rahat*, M. Kamrujjaman*, S. Banik, N. Sultana, N. Hassan, Z. Hossain and S. Yeasmin

Objective: In recent years, various rare earth ions doped glasses have been widely studied due to their high transparency, easy preparation and good strength. In this review, we have discussed about how dopants can change the structural, optical and physical properties useful for various applications in different fields.

Current progress: Cu doped zinc lithium borate glass was prepared by solid state melt quenching method. In this process, the best annealing temperature and time were found to be 300^0C and 30 min. While the optimum heating rate was 3^0C. Thermoluminescence (TL) intensity increases with the increase of dopant concentration and radiation dose from 0.5 to 4 Gy. Similarly, if there is another dopant added with Cu which is Na. TL response is found in the range of 0.5-1000 Gy. Another lithium magnesium borate glass is doped with CuO. In this case, the optimum annealing temperature was found to be 300^0C within 60 min. TL intensity increases with linear regression coefficient of 0.9980 and 0.9949 with the range of 1-10 Gy and 10-100 Gy. $Li_2 C0_3$ - $K_2 CO_3$ -$H_3 BO_3$ (LKB) co-doped with CuO and MgO was synthesized by the chemical quenching technique the TL intensity change with the dose range of 1-1000 Gy. Calcium lithium borate glass was doped with CuO prepared by melt quenching technique and irradiated with Co-60 gamma having different doses in the range of (0.5-4) Gy, (5-10) Gy, (20-100) Gy. The recorded glow curves consist a dominant peak at 187^0C for a heating rate of 5^0C s^{-1}. So, it has been realized that the compositions, preparation conditions and various dopants change characteristics. Such glasses are potential luminescence material for advanced technology.

* Department of Physics, Begum Rokeya University, Rangpur

1.38 Thermoluminescence Property of Phosphate Materials in Low Dose Dosimetry

A. K. M. M. Rahman, M. R. Rahat*, A. Mimi*, M. Kamrujjaman*, S. Banik, N. Sultana, N. Hassan, Z. Hossain and S. Yeasmin

Objective: Thermoluminescent Dosimeter (TLD) are one type of dosimeter where luminescence property of materials is used to measure radiation expose. Thermoluminescence (TL) is also called thermally stimulated

luminescence which refers to the process of electromagnetic radiation of a material commonly in visible light range when the material is heated in a certain temperature range.

Current progress: TL material can be used in different areas such as personal dosimetry, environmental dosimetry, medical research etc. The TL properties of materials varies with different doping by rare earth impurities in different hosts, which can be used for various applications in different fields. TLD materials such as borates, fluorides, sulphates, sulphides, phosphates are mostly used in different types of TLD for different purpose. Among them, phosphates are used for low dose dosimetry which opened a new window in radiation dosimetry. In this paper, phosphates as TLD material are reviewed. TL glow curve is analyzed for different phosphate with different host and doping and it is found that, phosphates are suitable for low dose radiation dosimetry.

* Department of Physics, Begum Rokeya University, Rangpur.

1.39 Cost effective and Eco-Friendly Synthesis of Silver Nano-Particles using Jack Fruit Plant Leaf and Their Application on Cancer Cell

M. F. Kabir, J. Ferdousy*, M. Z. Rahman** and M. M. Rahman**

Objective: To assess the anti-cancer activities of jack fruit plant leaf mediated Ag nanoparticles.

Current progress: During this reporting period, Nano particle synthesize and characterization has been carried out. Particle size and distribution were very suitable range and appropriate for cytotoxicity analysis. Nano particles were used to observe the anticancer properties in a cancer cell and it was shown strong activity against cancer cell. Seminar and journal paper were published on this research.

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** Department of Physics, University of Dhaka

1.40 Determination of Gross Alpha Radioactivity in Surface Water Collected from Twenty-Three Major Geographical Regions from Central Point of Dhaka City

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

Objective: To assess the Gross Alpha activity of surface water of selected area.

Current progress: These study gross alpha activities have been measured in 23 surface water samples collected in 2021 from different area of Shahbag and Ramana thana which are situated at the central point of Dhaka city. The main objective of this study is to determine the Gross alpha radioactivity in an environmental surface water sample. pH is an important parameter of water because there is a strong correlation between several water properties and this value. The p^H value of collected surface water was found from 6.7 to 7.5 in standard pH scale. The gross alpha activity of our collected surface water sample was ranged from< 7 to 28 $mBqL^{-1}$, and the average value approximately 18 $mBqL^{-1}$. There was not registered any exceeding of the maximum allowed limits for gross alpha activity stipulated in the national legislation. The values obtained in this study were compared with those presented in similar studies from Bangladesh and other regions of the world. This study aimed to provide an easier method to quantify the radioactive pollution in surface water and give a scientific basis for making policy decisions on radioactive pollution management. Moreover, this study will help to prepare national Survey data for gross alpha radioactivity in surface water samples which will be used as reference for the comparison of radioactivity level.

1.41 Determination of Gross Beta Activity in Surface Water Collected from Twenty-Three Major Geographical Regions from Central Point of Dhaka City

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

Objective: To assess the Gross Beta activity of surface water in 23 selected areas.

Current progress: The highest beta activity concentration is observed in descending order on samples 5, 23, 19, 13, and 6respectively; while the lowest beta activity is recorded in sample 1 and the second-lowest was in the sample. The maximum beta activity was observed at 120.864mBq/L and the Lowest activity was57.329 mBq/L which were collected from Dhaka University residential area. For the mean value calculation for both gross Alpha and Gross Beta radioactivity, the lowest and the highest value difference was not large. Moreover, the value is situated very lower than the recommended range of the World Health Organization (WHO).

1.42 Natural Antioxidant-Based Synthesis of Magnetic Silver Nanoparticles Using Some Medicinal Leaves and Their Applications Against Cancerous Cell and Multidrug-Resistant Strains

M. F. Kabir, M. Z. Rahman**, J. Ferdousy*, A. K. M. A. Ullah, M. M. Rahman** and M. N. I. Khan

Objective: To assess the Multidrug-Resistant Strains activities of plant leaf-mediated Ag nanoparticles.

Current progress: In the present study, silver nanoparticles (Ag-NPs) have been synthesized using three different medicinal leaf aqueous extracts of *Ocimum tenuiflorum*, *Cynodon dactylon*, and *Azadirachta indica* 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 revealed that the synthesized Ag-NPs have shown room-temperature ferromagnetic properties. The synthesized magnetic Ag-NPs were then exposed to 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). A clear zone of inhibitions was obtained indicating the materials as an effective drug against multi-drug resistant strains. Moreover, after exposing the synthesized Ag-NPs to cancerous HeLa cells no toxic effect was found up to a dose of 5 mg L^{-1}, indicating the safe use of the samples up to at least 5 mg L^{-1}. However, the synthesized Ag-NPs are found to be toxic against the targeted carcinoma cell at concentrations starting from 10 mg/L indicating their anti-cancerous property.

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** Department of Physics, University of Dhaka

1.43 Measurement of Gross Alpha and Gross Beta in Water from Various Pharmaceutical Companies of Bangladesh

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

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

Current progress: Twenty pharmaceutical water samples were collected randomly from different pharmaceutical companies which situated in different locations of Bangladesh. The gross alpha and gross beta activity in pharmaceutical water samples will be measured by using Zinc sulfide (ZnS) scintillation detector. All samples were collected and prepared according to the EPA 900 method. Till now eleven samples were measured by the detector. Among the measured sample minimum detected alpha activity is 0.002 Bq/L, beta activity is 0.04 Bq/L and maximum alpha activity is 0.009 Bq/L, beta activity is 0.14 Bq/L. Further work is in progress.

1.44 Occupational Radiation Exposure Among The Workers in Major Medical Practices

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

Objective: To understand the complete situation of the effectiveness of radiation protection practices in the workplace, especially in the medical fields where ionizing radiation is used for the purpose of diagnostic and therapy.

Current progress: The occupational radiation exposures for 799 workers were investigated in the fields of radiotherapy (RT), cardiology (CD) and nuclear medicine (NM) throughout Bangladesh in 2019 by using thermoluminescent dosimeter (TLD). A Harshaw TLD reader (Model-4500) was used to measure the effective dose in a quarterly basis throughout the year. Database was prepared and recorded on the basis of the value of personal dose equivalent (Hp (10)). The collective effective dose was 25.80, 39.72 and 11.11 man.mSv among 187, 263 and 349 radiation workers in RT, CD and NM, respectively.

2. Services Rendered

2.1 Services Rendered to Imported and Exportable Food Samples

During the reporting period, 2695 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	Individual Product	Monthly Total
Jul. 2021	8	70	78	2	80
Aug. 2021	41	184	225	3	228
Sept. 2021	60	108	168	6	174
Oct. 2021	60	233	293	6	299
Nov. 2021	69	211	280	4	284
Dec. 2021	58	213	271		271
Jan. 2022	73	272	345	3	348
Feb. 2022	50	118	168	15	183
Mar. 2022	73	148	221	-	221
Apr. 2022	78	188	266	-	266
May 2022	57	164	221	7	228
Jun. 2022	34	78	112	1	113
Grand Total					2695

2.2 Gross Alpha and Gross Beta Service Provided

	Type of sample	No. of sample	Total Parameters
Square Pharmaceuticals Ltd.	Bore hole Water	8	8
SK-F Pharmaceuticals Ltd. (BD)	Water	6	18
UL VS Bangladesh Ltd. Dhaka	Waste Water	3	9
Total		17	35

2.3 Service Provided to New TLD badges issued Organizations

Name of the month	No. of new Organizations	No. of new workers
Jul. 2021	2	3
Aug. 2021	23	158
Sept. 2021	41	88
Oct. 2021	21	73
Nov. 2021	24	67
Dec. 2021	9	11
Jan. 2022	10	24
Feb. 2022	31	104
Mar. 2022	28	67
Apr. 2022	30	49
May 2022	20	72
Jun. 2022	46	63
Total	285	775

2.4 Service of Dose Measurement and Reporting

During the reporting period, doses of 13100 TLD badges of 4365 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. 2021	54	87
Aug. 2021	364	1283
Sept. 2021	490	1745
Oct. 2021	310	760
Nov. 2021	401	1032
Dec. 2021	498	1320
Jan. 2022	374	1239
Feb. 2022	301	1044
Mar. 2022	501	1403
Apr. 2022	337	1109
May 2022	357	1117
Jun. 2022	378	961
Total	4365	13100

2.5 Individual Monitoring Service (IMS)

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 Jun. 2022, the total number of organizations and radiation workers came under this service was 5179 and 11288 respectively. Table 5 shows the practice wise organization and workers.

Practices	Number of Organizations	Number of radiation workers
Radiotherapy	15	500
Nuclear Medicine	18	503
Industrial Radiography	54	345
Diagnostic Radiology	4930	8869
Research	20	401
Others (Quality Control, Level Gauge etc)	142	670
Total	5179	11288

3. Seminar/Symposium/Conference/Workshop Attended

Name of the person	Title of the event	Organizer	Date	Place
S. Yeasmin	Advanced Instructor Training Course 2021	JAEA	26 Jul. - 4 Aug. 2021	Online
	Technical Meeting on Methods for Radiological and Environmental Impact Assessment (MEREIA)	IAEA	4-8 Oct. 2021	Online
	International Conference on Electronics and Informatics 2021	Bangladesh Electronics and Informatics Society (BEIS)	27-28 Nov. 2021	AECD
	International Conference on Physics-2022	Bangladesh Physical Society	19-21 May 2022	AECD

Name of the person	Title of the event	Organizer	Date	Place
	International conference on Physics in Medicine (ICPM)-2022	Bangladesh Medical Physics Association and Bangladesh Atomic Energy Commission	26-27 May 2022	AECD
Dr. M. S. Rahman	International Conference on Radioactive Waste Management: Solutions for a Sustainable Future	IAEA	1-5 Nov. 2021	IAEA HQ, Vienna, Austria
	International Conference on the Safe and Secure Transport of Nuclear and Radioactive Materials	IAEA	13-17 Dec. 2021	IAEA HQ, Vienna, Austria
	International Conference on Safety and Security of Radioactive Sources: Accomplishments and Future Endeavors	IAEA	20-24 Jun. 2022	IAEA HQ, Vienna, Austria
	International Conference on Physics-2022	BPS	19-21 May 2022	AECD
	International Conference on Physics in Medicine-2022	BMPA	26-27 May 2022	AECD
	International e-Conference on Physics 2021	DU	09-11 Jul. 2021	Zoom Platform
	National Conference on Physics-2021	BPS	6-7 Aug. 2021	Zoom Platform
J. Ferdous	Technical Meeting/workshop on the Updated IAEA Database on Discharges of Radionuclides to the Atmosphere and Aquatic Environment (DIRATA)	International Atomic Energy Agency (IAEA)	6 - 10 Jun. 2022	Vienna, Austria (Virtual)
	Workshop on International Radiation Monitoring Information System (IRMIS) implementation	International Atomic Energy Agency (IAEA)	29 Nov.- 01 Dec. 2022	Vienna, Austria (Virtual)
M. M. M. Siraz	28th BAB Assessor Training Course on ISO/IEC 17025:2017	Bangladesh Accreditation Board	26-30 Sept. 2021	BAB
	International Conference on Electronics and Informatics 2021	Bangladesh Electronics and Informatics Society (BEIS)	27-28 Nov. 2021	AEC, Dhaka
	International Conference on Physics-2022	Bangladesh Physical Society	19-21 May 2022	AEC, Dhaka
	International conference on Physics in Medicine (ICPM)-2022	Bangladesh Medical Physics Association and Bangladesh Atomic Energy Commission	26-27 May 2022	AEC, Dhaka
S. Pervin	International Conference on Electronics and Informatics 2021	Bangladesh Electronics and Informatics Society	27-28 Nov., 2021	AEC, Dhaka

Name of the person	Title of the event	Organizer	Date	Place
	International Conference on Physics 2022	Bangladesh Physical Society	19-21 May 2022	AEC, Dhaka
	International conference on Physics in Medicine	Bangladesh Medical Physics Association	26-27 May 2022	AEC, Dhaka
	Virtual Regional Training course on NST Specialized Programme in the field of Radiation Protection	Tokyo University, Japan	5 Aug. - 1 Sept. 2021	Tokyo University, Japan (Virtual)
	28th BAB Assessor Training Course on ISO/IEC 17025:2017	Bangladesh Accreditation Board	26 -30 Sept. 2021	NPO Seminar Hall, Dhaka
N. Hassan	International Conference on Electronics and Informatics 2021	Bangladesh Electronics and Informatics Society	27-28 Nov. 2021	AEC, Dhaka
	International Conference on Physics 2022	Bangladesh Physical Society	19-21 May 2022	AEC, Dhaka
S. Banik	International conference on electronics and informatics 2021	Bangladesh Electronic Society	27-28 Nov. 2021	AEC, Dhaka
	Physics for 4th industrial revolution and beyond	Bangladesh Physical Society	19-21 May 2022	AEC, Dhaka
	International conference on Physics in medicine: Creating awareness of medical physics in cancer care	Bangladesh Medical Physics Association	26-27 May 2022	AEC, Dhaka
N. Sultana	International Conference on Electronics and Informatics 2021	Bangladesh Electronics and Informatics Society (BEIS)	27-28 Nov. 2021	AEC, Dhaka
	International Conference on Physics-2022	Bangladesh Physical Society	19-21 May 2022	AEC, Dhaka
	International conference on Physics in Medicine (ICPM)-2022	Bangladesh Medical Physics Association and Bangladesh Atomic energy Commission	26-27 May 2022	AEC, Dhaka
	Follow -up Training Course on "Nuclear and Radiological Emergency Preparedness"	Bangladesh Atomic Energy Commission & Japan Atomic Energy Agency	21 Nov. - 2 Dec. 2021	TI, AERE
	38th Understanding Training Course on ISO/IEC 17025:2017	Bangladesh Accreditation Board	6 - 8 Dec. 2021	Ministry of Industries, Dhaka
M. F. Kabir	Right to information Act	Scientific information Division	18 0ctober 2021	Zoom platform
	International Conference on Physics-2022	Bangladesh Physical Society	19-21 May 2022	AEC, Dhaka
	International Conference on Physics-2022	Bangladesh Physical Society	19-21 May 2022	AEC, Dhaka

Name of the person	Title of the event	Organizer	Date	Place
	Seminar on "Simultaneous Determination of Gross Alpha/Gross Beta Radioactivity in Surface Water Collected from Several Geographical Points of Shahbag and Ramna"	Atomic Energy Centre, Dhaka	15 Jun. 2022	AEC, Dhaka

4. Training Course Organized and Seminar Arranged

Title	Date	Place	No. of participants
Importance of radiation monitoring for radiation worker & public safety	10 Apr. 2022	AEC, Dhaka	46
Seminar on "Simultaneous Determination of Gross Alpha/Gross Beta Radioactivity in Surface Water Collected from Several Geographical Points of Shahbag and Ramna"	15 Jun. 2022	AEC, Dhaka	46

5. Collaboration Work(s)

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

- RAS/9093 -Strengthening Technical Services in Occupational Radiation Protection in Compliance with the International Basic Safety Standards
- Special Research Allocation Project: 2020-2021 under MOST, GOB
- Grant of Advanced Research in Education: 2020-2021, 2021-2022, 2022-2023 under MOE, GOB
- To enhance knowledge on radiological science the senior scientists of HPD have been delivering theoretical lectures in the field of Health physics & Radiation Protection in the following areas:
- MD course in Nuclear Medicine (NINMAS)

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 Buildup 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 programme of BAN-02, International Science Programme, 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 programmes from various public and private universities under national and international collaboration. The division also provides supports and services to the industrial and research organizations.

Programme

- 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 / materials and study their applications using MRI and hyperthermia matchine
- 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/ nanocrystallinematerials
- 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
- 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_3Loated ceramic materials for biomedical Application
- Preparation of functionalized Carbone nanotube Applications
- Synthesis of Graphine Oxide and Reducel and its application as biomedical coating.

Activities

1. Research and Development Work(s)

1.1 Incorporation of $CoFe_2O_4$ Nanoparticles in Chitosan-PEG Scaffold for Enhanced Wound Healing

S. M. Hoque,M. N.I. Khan, M. A. Mamun, H. N. Das, S. I. Liba, R. Rashid, M. R. Hasan, A. Parveen, A. A. Begum, K. H. Fakir, N. Begum and M. Dilshad*

Objective: The objective of the work is to Incorporation of $CoFe_2O_4$ nanoparticles in Chitosan-PEG scaffold for enhanced wound healing

Current progress: The study is carried out to prepare nanoparticles incorporated scaffold from the blend ofChitosan and PEG which is crosslinked by formaldehyde linkage method. Chitosan coated $CoFe_2O_4$ nanoparticles were added to the scaffold for their antibacterial and angiogenic activities. $CoFe_2O_4$ nanoparticles were synthesized by co-precipitation method. The crystallite size, chemical bonds, surface morphology, elemental analysis, particle size, thermal property were determined by X-Ray Diffraction (XRD), Fourier Transform Infrared Spectroscopy (FTIR), Scanning Electron Microscope (SEM), Energy Dispersive X-ray Spectroscopy (EDS), Transmission Electron Microscope (TEM) and Thermo-Gravimetric Analysis (TGA) respectively. The results obtained from XRD analysis confirmed the formation of $CoFe_2O_4$ nanoparticles. The characterization results from FT-IR and EDS confirmed the successful incorporation of $CoFe_2O_4$ nanoparticles in the scaffold. TGA has proved the thermal stability of the scaffold. Proper swelling of the scaffold helped in sustained release of the nanoparticles from the scaffold. The scaffold showed excellent antimicrobial activity against S. aureus. The cell viability of the prepared scaffold was found above 95% and thus it is validated that the scaffold is biocompatible and non-toxic for biomedical application. The in-vivo test validated the enhanced wound healing effect of the scaffold.

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1.2 PEGylation of $Mg_xCo_{1-x}Fe_2O_4$ Nanoparticles and their Conjugation with Doxorubicin for a Comparative Study of Drug Loading and Drug Release in Hyperthermia based Anticancer Drug Delivery Process

S. M. Hoque, M. N. I. Khan, M. M. Haque, M. A. Mamun, H. N. Das, S. I. Liba, R. Rashid, M. R. Hasan, A. Parveen, A. A. Begum, K. H. Fakir, N. Begum and S. Hossain*

Objective: PEGylation of $Mg_xCo_{1-x}Fe_2O_4$ nanoparticles and their conjugation with doxorubicin for a comparative study of drug loading and drug release in hyperthermia based anticancer drug delivery process

Current progress: Nowadays nanoparticles are being designed widely with a biocompatible surface coating for effective drug delivery applications, In this study, Magnesium doped Cobalt ferrite nanoparticles $Mg_xCo_{1-x}Fe_2O_4$(x=0.3,0.5,0.7,0.9) have been inspected for drug delivery purpose. These nanoparticles are prepared by precipitation method and coated with Polyethylene Glycol(PEG) by sonication. Nanoparticles are coated with PEG to improve their blood circulation time. Coating as been confirmed by Fourier Transform Infrared spectroscopy (FTIR). Dynamic Light Scattering (DLS) confirms that these PEG coated nanoparticles have hydrodynamic size 260 nm on average and polydispersity Index (PDI) less than 0.4 at room temperature. Magnetic properties of these PEG coated nanoparticles, investigated in Physical Property Measurement

System (PPMS) suggest that these coated nanoparticles are superparamagnetic in nature. According to cytotoxicity test PEG coated nanoparticles have no cytotoxic effect on vero cell. Doxorubicin, a widely used anticancer drug is conjugated with these coated nanoparticles. Drug loading capacities of these nanoparticles at 25°C are observed by means of UV-VIS Spectroscopy and High-Performance Liquid Chromatography (HPLC) and has been confirmed by FTIR. Time dependent drug re;ease of Doxorubcin of these PEG coated nanoparticles is observed by exposing the drug loaded nanoparticle in magnetic hyperthermia.Drug release measurement is obtained UV-VIS Spectroscopymand HPLC at 42°C. It is observed that nanoparticles with higher concentration of Magnesium exhibit better drug release efficiency. The objective of this work is analyzing the efficiency of $Mg_xCo_{1-x}Fe_2O_4$ nanoparticles to assist the transportation of chemotherapy drugs directly to cancerous growth.

*Dept. of Physics, Dhaka University, Dhaka

1.3 DevolopmentandCharacterization of Cellulose Based Food Package Coated with Chitosan and Containing $TiO_2$and Ag/TiO_2Nanoparticles

S. M. Hoque, M. N. I. Khan, M. A. Mamun, H. N. Das, S. I. Liba, R. Rashid, M. R. Hasan, A. Kumar, A. Parveen, A. A. Begum, K. H. Fakir, N. Begum and S. K.Singha*

Objective: Study of Development and characterization ofCellulose based food package coated with chitosan and containing TiO_2 and Ag/TiO_2 nanoparticles

Current progress: The present study was carried out to develop biodegradable packaging material for food packaging. Cellulose-based papers dip coated in (P-CS), chitosan-TiO_2 (P-CS-TiO_2) and chitosan-Ag/TiO_2 (P-CS-Ag/TiO_2), respectively were aged for 4 months at 25°C, 55% relative humidity, 15h light/9h dark cycle and characterized in relation to plain paper (P). Physicochemical properties were observed before and afterageing. The reduction in the chitosan crystallinity, N-deacetylation of chitosan and loss in the active agents (proven by SEM, FTIR,EDX techniques and physical-chemical-microbial measurements) occurred during ageing explains the deterioration of the barrier and antimicrobial properties of the active papers and subsequently the decrease in their preservation efficiency. During the study Ag/TiO_2nanocimposite was synthesized and using TEM technique the size of Ag nanoparticle was measured in 20 nm scale and shows crystallinity. Compared with the uncoated paper the pores of the cellulose paper were filled finely after coating which is important for improving barrier properties of a package. SEM image showed that the surface of the paper was smooth, glossy and nothing unusual was observed and the molecular composition of all materials in packages were uniform. From the FTIR spectra, N-acetylation of paper during ageing was observed and the chitosan was not fully deacetylated. Photocatalytic activity of active paper was evaluated by decomposition rate of Methyl Orange using UV-Vis spectrophotometer. Experimental results indicate that before and after ageing for 4 months the most effective package was P-CS-Ag/TiO_2 for which exhibits the highest levels of photo catalytic activity (20% degradation) and showed the highest inhibition zone against E. coli (9.47 mm).

*Department of Food Technology and Rural Industries Bangladesh Agricultural University

1.4 Dextran Coated Magnetic $Co_xMg_{1-x}Fe_2O_4$ Nanoparticles: Study of Drug Release Capacity in Hyperthermia-triggered Anti-Cancer Drug Delivery

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

Objective: To dextran coated magnetic $Co_xMg_{1-x}Fe_2O_4$ nanoparticles: study of drug release capacity in hyperthermia-triggered anti-cancer drug delivery

Current progress: Polymer coated magnetic nanoparticles have great potentials as prospective drug carrers in cancer treatment to minimize anti-cancer drug build-up in healthy tissue. In this study, Co-Mg Ferrite ($Co_xMg_{1-x}Fe_2O_4$; x-0.2,0.4,0.6,0.8) nanoparticles have been studieds to use as drug carriers. The nanoparticles have been coated with Dextran to increase biocompatibility and this cpating is validated by Fourier Transform Infrared(FTIR) Spectroscopt. Cytotoxicity test on vero cell line and HeLa cell line have exhibited excellent(>95%) cell survival rate after applying the coated sample. According to Dynamic Light Scattering (DLS) results, the coated particles have a hydrodynamic diameter of less than 350 nm on average and the polydispersity index value of each sample is less than 0.5 expect some small deviations. Vibrating Sample Magnetometer (VSM) analysis has revealed that magnetic properties of the coated ferrites get more

pronounced with higher Cobalt substitution in the sample. Doxorubicin, a chemotherapeutic drug, has been loaded on the coated sample which is confirmed by FTIR. Drug loading percentage has been observed using High Performance Liquid Chromatography (HPLC). The Samples with higher Magnesium content exhibit greater drug loading capacity. Hyperthermia-induced drug release in Phosphate Buffer Saline (pH 7.4) over 1 hour has been observed for each sample.The HPLC peaks for Doxorubicin increases in area with time which implies release of Doxorbcin in the PBS medium. Better drug release has been observed for samples with grater Cobalt content. This study shows that Dextran coated Co-Mg ferrite nanoparticles are promising candidates as efficient drug carriers.

*Dept. of Physics, Dhaka University, Dhaka

1.5 Development of Nanohydeoxyapatite-Chitosan Gelatin Scaffoldsthe Analysis of Osteoblastin Rabbit Model (in vivo)

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

Objective: Development of nanohydeoxyapatite-chitosan gelatin scaffolds the analysis of osteoblast in rabbit model (in vivo)

Current progress: Hydroxyapatite nanoparticles were synthesized by wet chemical precipitation method with Ammonium hydrogen phosphate and calcium nitrate tetra hydrate precursors, respectively. The ph of the solution was controlled at 10.8 by mixing 0.1 M Sodium hydroxide throughout the stirring process. The mixture was allowed to remain overnight and white precipitation was formed at the bottom of the beaker. The precipitate was washed out through centrifugation to remove sodium hydroxide. After that the solution was dehydrated by heating at 40°C with the help of heat and stirrer machine for 72 hours. The white hydroxyapatite was grained to make a fine nano-powder. Then the HAP was used to prepare HAP:Chitosan: Gelatin (10:40:50 &21:49:30) bio-composites to ensure the biocompatibility of the scaffolds through biological application. The HAP powder and scaffolds were characterized through XRD (X-ray diffraction technique), Elemental Dispersive X-ray(EDX),Fourier Transform Infrared Spectroscopy(FTIR), Raman Spectroscopy, Scanning Electron Microscope(SEM), Transmission Microscope(TEM) analysis and thermal stability was assessed with Thermo gravimetric analysis(TGA). At last the scaffolds were surgically implemented into the Latissimus dorsi muscle of the rabbit (in vivo) and histopathological studies were performed to analyze the newly formed obteoblasts in tissues due to nano HAP-Chitosan-Gelatinimplant.

* Department of Food Technology and Rural Industries Bangladesh Agricultural University

1.6 Synthesisof Novel Magnetite Nanoparticleswith Chitosaan Mesoporoussilica Coating for Efficient Removal of Heavy Metals from Wastewater

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

Objective: Synthesis of novel magnetite nanoparticles with chitosaan mesoporoussilica coating for efficient removal of heavy metals from wastewater.

Current progress: Contamination of natural water resources by heavy metal pollutants present in wastewater has become a worldwide concern. Removal of heavy metal ions by surface functionalized magnetic nanoparticles absorption is an economical route due to its simplicity and easy operation. However, bare magnetite nanoparticles are not good adsorbents and are susceptible to oxidation and agglomeration. The challenge is to develop economically feasible magnetite nanomarticles with an appropriate surface functionalization that will simultaneously provide adsorptionefficiency, hydrophilicity and recyclability without compromising magnetic properties. The aim of this study was to develop magnetite nanoparticles with a combined coating of chitosan and mesoporous silica which would act as an efficient adsorbent of heavy metal ions i.e., $Pb^{2+}Cd^{2+}$ and As^{3+} from water.The Fe3O4 nanoparticles were synthesized via thermal decomposition method of iron-oleate precursor. The synthesized particles were subjected to X-ray diffraction (XRD), Physical Propertiey Measurement System (PPMS)and Transmission Electron Microscopy (TEM) to determine the crystalline phase, crystallite size, magnetic properties and morphology respectively. The coating of mesoporous silica was formed on the particles by reaction of phase transferring them with the help of Cetrimonium bromide (CTAB) and addition of Tetraethyl orthosilicate (TEOS). The chitosan coating over the mesoporous silica coated particles was put by subjecting the particles to 5% chitosan solution in acetic

acid with pH 6.0. The successful formation of the coatings was confirmed by conducting Fourier-transform infrared spectroscopy (FTIR) analysis. The coated particles were used as adsorbents for Pb^{2+}, Cd^{2+} and As^{3+} present in water. During the adsorption experiments the contact time and initial concentration parameter varied and the corresponding data was fitted to pseudo-first order and pseudo-second order kinetic model to determine the adsorption mechanism. The data was also fitted to the Langmuir and Freundlichadsorption isotherms. The data demonstrated a closer fifing to the Pseudo-2^{nd} order kinetic model and the Langmuir Isotherm model. Based on these results the adorption process is determined to be a monolayer chemisorptions and the particles were concluded to be an efficient heavy metal adsorbent.

*Department of Materials and Metallurgical Engineering, BUET

1.7 An On-site Review on Nanomaterials Synthesis through Chemical Methodology and Novel Characterizations for Biomedical Applications

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

Objective: An On-site review on nanomaterials synthesis through chemical methodology and novel characterizations for biomedical applications.

Current progress: During my freshman year spring semester, I traveled abroad to work with Dr. Sheikh Manjura Hoque at Bangladesh Atomic Energy Commission, a scientific research organization and regulatory body of Bangladesh on nuclear energy. The commission is dedicated to harnessing and utilizing nuclear energy to uplift and empower Bangladesh. This is reflected in the development of Rooppur Nuclear Power Plant, a project I myself was not involved with, but saw fast hand the meticulous planning and execution. I was specifically at Materials Science Division of the Atomic Energy Centre subsidiary.

I myself a public health and medicine student, and have had previous experience with doing research at Yale Medical School with Dr. Fahmeed Hyder`s Labs, where using NMR proton spectroscopy, we were able to enhance the properties of contrast, a feat that will advance MRI readings and allow for more accurate diagnostics and targeted therapy treatments. My work with the Atomic Energy Centre not only consisted of mainly assisting ongoing projects, but was also a learning experience providing the foundations of biomedical research as I continue my career in research. My role in my prior lab was data collection and statistical analysis, as well as proof reading and writing papers. I greatly enjoyed this, but I wanted to gain procedural experience, and I learned multiple resource techniques and research methods which I will outline below. Each of these different skills taught me a different aspect to NMRI and material science as a whole.

I first learned how to synthesize a nanoparticle using the sol gel method. A sol is a solution that exhibits the tyndall effect which is the exhibition og light scattering by particles in a colloid, or a liquid that has very fine suspension. This can be seen when it is overcast and sunlight passes through the turbid layer of a cloud. In this specific lab, we use solgel synthesis to create metal cations. I personally created a lanthanum nanoparticle. The procedure I followed to make this was combining lanthanum nitrate and manganese nitrate and dissolving this in DI water. This acts as a single displacement reaction, and the lanthanum and manganese combine. Through perfecting the process multiple times, we also have determined to add citric acid as a catalyst for a process called hydrolysis, where elements break down and reformdue to the addition of –OH bonds.This then yields a homogenous gel. We dry this solution at 90 degrees' fir 5 hours in a specific oven, which I learned operated using centripetal force. After drying this gel, we grind it into a fine powder, which I first hand saw the beginnings of nanoparticle formation. We then add calcite, which changed the bravais lattice structure. As a medical student, I learned for the first time what a bravais lattice structure was, since it is unique to crystalline structure. I also learned there are 14 different configurations possible. Changing the bravais lattice structure of a molecule means to also change the properties of the molecule itself. After grinding the solution, we heat it in a high temperature furnace at 800 degrees Celsius, in which we finally yield the final product, the lanthanum magnate nanoparticles we are going to test to see if they enhance MRI readings.

Another nanoparticle synthesis I had the opportunity to observe was a chitosan Nanoparticle synthesis. I learned that Chitosan is polysaccharide, which comes from a shrimp or lobster exoskeleton. Chitosan nanopartical are biocompatible, relatively non-toxic, biodegradable, and cationic in nature. Thus, theynarenwell accepted in biomedical applications such as drug delivery and NMR. NMR works best when a

cation (specifically protons because proton spectra are the easiest to obtain.) Ionic gelation is the most commonly used method for synthesizing chitosan nanoparticles complex. I thus assisted in an ionic gelation procedure, by utilizing the electrostatic interactions between and nanoparticles. For our chitosan experiment, were testing to see if it not only enhanced contrast, but it could also have antimicrobial properties against E. Coil and Streptococcus Aureus.

In order to test for the antimicrobial properties, I had to learn how to create a bacteria culture. I followed the zone of inhibition method where I prepared an agar culture, by adding an osmate suspension agent, and heating it. Then, I created two wells using a cylinder. I also learned the difference between streaking and swabbing a cell all over the plate. After incubation the final size of the zone of inhibition is indicative of the level of antimicrobial activity; a large zone means that particular nanoparticle is a stronger antibiotic. As a medical student, I found this to be the most invaluable experience within this lab, as this is a skill that I can carry with me throughout my academic career.

After creating these nanoparticles, I had to learn how to characterize them. In this connection, I learned to operate differential scanning calorimetry/thermogravimetric analysis, Raman Spectroscopy, Fourier Transform Infrared Spectroscopy, Physical Properties Measurement System. I used extensively transmission electron microscope the transmission electron microscope and electron dispersive X-ray spectroscopy (EDS). Each of these required multiple days of training for operation.

The TEM was memorable in particular because of microscopes that use a particle beam of electrons to visualize specimens and generate a highly-magnified image. An electron gun at the top of a TEM emitselectrons that travel through the microscope`s vacuum tube. Rather than having a glass lens focusing the light (as in the case of light microscopes), the TEM employs an electromagnetic lens which focuses the electrons cither scatter or hit a fouorescent screen at the bottom if the microscope. Specimens must be very thin so that electrons are able to pass through the tissue. For biological samples, this may be done by cutting very thin slices of a specimen`s tissue using ultramicrotome and must also completely dehydrated (all water removed). I prepared the specimen, and also put it through the TEM, only our machine is calibrated so that it passes through the first and second condenser lenses. I also learned that sample cannot be exposed to the TEM for long periods of time, or else the photon will ultimately ruin the copper grid. I acquire images at various magnification, the highest magnification was one million. At this magnification I could observe lattice fringes or atomic arrangement in a lattice of a crystalline material.

EDX is another important microscopy technique which acts similarly to the TEM only in that it uses radioactive x-rays instead of electrons for compositional analysis. When the x-rays hit the elections, they jump from different shells, and this scattering generates a characterization capability. We can differentiate between different elements due in large part to the elemental/compositional analysis that contributes toa large extent to the contrast of MRI scan.

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1.8 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. Parveen, A. A. Begum, K. Hasan, A. Hossain, Z. Begum and N. Begum

Objective: 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 are found to be in good agreement with reported values and are lowed with

*Materials Science Division, Atomic Energy Centre, Dhaka

1.9 Synthesis and Magnetoelectric 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.Parveen, A. A. Begum, K. H. Fakir, A. Hossain, Z. Begum and N. Begum

Objective: 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.

1.10 Studies of Structural and Optical Properties of V_2O_5 Synthesized by Hydrothermal Technique

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

Objective: Studies of structural and optical properties of V_2O_5 synthesized by hydrothermal technique.

Current progress: In this study Vanadium pentoxide (V_2O_5)has been synthesized using facile hydrothermal method at six different temperature ranging from 100 to 200 °C, with each step of 20 °C. The influence of hydrothermal reaction temperatures on thesynthesis and physical properties of V_2O_5 has been investigated by different techniques. The XRD pattern confirms the stable orthorhombic crystal structure of the synthesized samples at all reaction temperatures. In addition, there is no other extra peak are found in the XRD pattern which confirmed the formation of pure orthorhombic phase of V_2O_5.The SEM and TEM images demonstrate the particlelike morphology, and these characterizations affirmed that the particles size became larger with the increase of reaction temperatures. The FTIR analysis is employed to study the functional groups, and obtained results are consistent with XRDanalysis. The bandgap has been estimated at various reaction temperatures using UV-vis diffuse reflectance spectra (UV-DRS) and was found to be between 2.08 to 2.15 eV, which are suitable range for absorbing a significant amount of visible light. The photocatalysis of methylene blue (MB) with synthesized samples has been accomplished to investigate photocatalytic efficiency. The pure V_2O_5 synthesized at lower reaction temperature (100 °C) possesses a lower bandgap and, accordingly, higher photocatalytic efficiency.

* Department of Physics, Chittagong University Engineering & Technology

1.11 Structural and Elemental Analysis of Various Colored Rocks Available in Jaflong and Bholagonj Area of Sylhet

M. N. I. Khan, S. M. Hoque, M. M. Haque, M. R. Hasan, A. Nahar, A. Parveen, A. A. Begum, M. N. Islam, N. Begum, M. A. Kayum and M. Salauddin*

Objective: Structural and elemental analysis of various colored rocks available in Jaflong and Bholagonj area of Sylhet.

Current progress: There exist plenty of naturally occurring various colored rocks in Jaflong and Bholagonj regions of Sylhet district. This work is aimed at discovering minerals reside in the roks in those regions and to justify their potential uses. Samples have been collected from 10 locations of Bholagonj. Black, red and white rock samples are collected from each location. Rock samples are converted into powder form using a stainless steel hammer for X-ray diffraction (XRD) measurements. Intensity versus scattering angle patterns of XRD have been analyzed by Rigaku Smartlab Studio-II software incorporated with Rietveld refinement. Very good diffraction patterns are obtained for white and red rocks. The patterns for black's rocks are not so good, and it may be due to the destruction of crystalline state of the samples while hitting by the hammer. Various minerals are indentifiedin the rocks. Identified minerals in black rocks are coesite HP (SiO_2), Ferro-holmquistite [$\{Li_2\}\{Fe^{2+}{}_3Al_2\}(Si_8O_{22})(OH)_2$], Quatz low HP, Potassium Titanium oxide, Albite low HP (Sodium tecto-alumotrisilicate), alnite intermediate, etc. White rocks contain quartz low high HP, Glagolevite ($NaMg_6(AlSi_3O_{10})(OH,O)_8$), quartz low HP, etc. Minerals detected in the red rocks are silicon dioxide, quartz low high HP, Albite ($NaAlSi_3O_8$), quartz low High HP, Albite ($NaAlSi_3O_8$), Rutile HP (TiO_2),Microcline ($K(AlSi_3O_8)$), etc. It is found that the elements detected by the XRD, This result indicate that all the existed compounds in the rock samples have not been identified by XRD measurements. This means, there is a possibility to exist some compounds in the noncrystalline state, orwe might not propwerly fit the peaks corresponding to some compounds in the polycrystalline state.

* Department of Physics, Shahjalal University of Science and Technology

1.12 Synthesis and Characterization of Ag doped $ZnFe_2O_4$ Nanoparticles in Solar Cell application, $Zn_{1-x}Ag_xFe_2O_4$ [x=0.0, 0.1, 0.2, 0.3, 0.4]

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

Objective: Synthesis and characterization of Ag doped $ZnFe_2O_4$ nanoparticles in solar cell application. $Zn_{1-x}Ag_xFe_2O_4$[x=0.0, 0.1, 0.2, 0.3, 0.4].

Current progress: Nanoparticles of spinel ferrites are potential candidates with respect to research as well as industrial point of view due to their distinctive and remarkable magnetic, electrical and structural properties. Ag doped $ZnFe_2O_4$ nanoparticles of $Ag_xZn_{1-x}Fe_2O_4$ (x=0.0, 0.1, 0.2, 0.3, 0.4) with spinel structure were synthesized by sol –gel method. The preparation of silver doped zinc ferrite following the same procedure which was selectedas the best approach as described in a previous study. This nanoparticles were prepared by low cost and nontoxic route. It was assumed that there must be a correlation between the heat treatment operational parameter and the structural properties of the material being synthesized. Similarly, it was understood that some heat treatment is necessary to completely decompose the organic and nitrate contents present in the amorphous powder. The particle size distributions of these new batches of nanoparticles were estimated to be in the range 5-58 nm. The synthesized products were investigated by standard characterization technique such as X-ray diffraction (XRD), FT-IR spectroscopy, UV spectroscopy, Scanning Electron Microscopy (SEM), Dynamic Light Scattering (DLS), Differential Scanning Calorimetry (DSC), Thermo Gravimetric Analysis (TGA), and Physical Properties Measurement (PPMS).The optical temperature was obtained at 600°C. Prepared Ag doped $ZnFe_2O_4$ nanoparticles can be considered as a promising material for energy conversion and solar cell applications. Where a low band gap semiconductor that will able to convert higher band gap semiconductor.

* Department of Physics, Cumilla University

1.13 Synthesis and Characterization of Europium Doped Nickel Zinc Cobalt Ferrite

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

Objective: Synthesis and characterization of europium doped Nickel Zinc Cobalt ferrite.

Current progress: The present work is focused on influence of europium (rare earth) doped Ni-Zn-Co ferrites. The ferrite sample of the composition $Ni_{0.5}Zn_{0.3}Co_xEu_xFe_2O_4$ (Where x=0.00,0.02,0.04,0.06, 0.08,0.10) was synthesized using conventional solid-state reaction method from the oxide powders of Ni, An, Co, Eu and Fe. Effects of ferrite contents on the structural, electrical, magnetic and dielectric properties were thoroughly investigated. The structural properties and phase identification werestudied by using X-ray diffraction (XRD) and the analyses found spinel cubic structure for ferrite samples. XRD pattern of NZCEF has been introduced with $EuFeO_3$ secondary peak. The lattice parameter found increasing with Eu concentrations (maximum at x=0.10). The x-ray density and bulk density were found decreasing from 15.43% 39.28% as the `x` was increased from 0.02 to 0.10. FTIR analyses confirmed the oxygen metal- oxygen bonds in ferrite structures. The average grain size variation was uniform for ferrite contents. The large grain size 1.380 µm was notced where x=0.02 and smallest grain size valur 1.32 µm fir the x=0.10. VSM was used to calculate the M-H loop at room temperature. The magnetization of the samples found maximum fore the pure ferrite content and then decreases up to x=0.06 content. The maximum value of saturation magnetization is 83.0262 emu/gm and minimum value is 64.7140 for x=0.10. Permeability and dielectric constant were found decreasing at lower frequency and at higher frequency they become almost constant with frequency. The real part of dielectric constant is maximum for x=0.00 and then reduces with increasing ferrite contents. The resistivity decreases with increasing frequency which is the general properties of ferrite. The high resistivity was observed in this study and also noticed that from the obtained data the resistivity increased with the addition of frerrite contents in the sample. The sample x=0.10 ferrite concentration up to x=0.10 and the improvement of resistive property of the sample. The maximum impedance noticed there is for x=0.06 contents. From the observed magnetic, dielectric and electrical properties optimum content of composition for this material can be found which makes it good candidate potential applications in storage device, magnetic sensors and spintronic devices.

* Department of Physics, Khulna University

1.14 Magnetocaloric Properties and Analysis of The Critical Point Exponents of $Pr_{0.55}Ca_xSr_{0.45-x}MnO_3$ (x = 0.00, 0.05, 0.1 and 0.2) at PM-FM Phase Transition

R. Rashid, A. Nahar, R. Hasan, M. N. I. Khan, S. M. Hoque, A. Qayium, A. Parvin, A, Begum, N. Islam and M. A. A. Bally*

Objective: Magnetocaloric properties and analysis of the critical point exponents of $Pr_{0.55}Ca_xSr_{0.45-x}MnO_3$ (x = 0.00, 0.05, 0.1 and 0.2) at PM-FM phase transition.

Current progress: The polycrystalline manganite $Pr_{0.55}Ca_xSr_{0.45-x}MnO_3$ (x = 0.00, 0.05, 0.1, and 0.2) has been prepared by the solid state reaction technique to investigate its crystal structure, magnetic, and magnetocaloric properties. Critical behaviour around PM-FM phase transition has also been analyzed through various methods including modified Arrott plots (MAP), and critical isotherm analysis of $Pr_{0.55}Ca_xSr_{0.45-x}MnO_3$ (x = 0.00, 0.05, 0.1, and 0.2). XRD analysis reveals that all the samples are found to be crystallized in the orthorhombic system with Pnma space group and lattice parameters a, b and c as well as the cell volume are found to decrease with increasing Ca (x) content. Microstructure is observed with the field emission scanning electron microscopy (FESEM) photograph and elemental compositions are determined by energy dispersive X-ray diffractometer (EDX). Temperature and field dependent magnetization measurement disclose that all the samples undergo second-order FM to PM phase transition but the T C value decreases from 290 K to 245 K with the increase in Ca (x) content from 0.00 to 0.20. The magnetocaloric effect (MCE) in terms of maximum entropy change, $(-\Delta S_m)_{max}$ and relative cooling power (RCP) was calculated from isothermal magnetization measurements around T C , using Maxwell's thermodynamic relations. Both $(-\Delta S_m)_{max}$ and RCP increases with increasing Ca content suggests the suitability of this compound as a potential solid state refrigerent. Contribution of itinerant electron in the entropy change is found from modulating MCE with Landau theory of phase transition.

* Materials Science Division, 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	International Conference on Electronics and Informatics 2021	BES	27-28 Nov. 2021	AECD
	International Conference on Physics-2022	BPS	19-21May 2022	AECD
Engr. F. M. Kamal	International Conference on Electronics and Informatics 2021	BES	27-28 Nov. 2021	AECD
	International Conference on Physics-2022	BPS	19-21 May 2022	AECD
Dr. M. M. Haque	International Conference on Electronics and Informatics 2021	BES	27-28 Nov. 2021	AECD
	International Conference on Physics-2022	BPS	19-21 May 2022	AECD
Dr. Mohammad Nazrul Islam Khan	International Conference on Electronics and Informatics 2021	BES	27-28 Nov. 2021	AECD
	International Conference on Physics-2022	BPS	19-21May 2022	AECD
Dr. M. A. Mamun	International Conference on Electronics and Informatics 2021	BES	27-28 Nov. 2021	AECD
	International Conference on Physics-2022	BPS	19-21May 2022	AECD
Dr. H. Das	International Conference on Electronics and Informatics 2021	BES	27-28 Nov. 2021	AECD
	International Conference on Physics-2022	BPS	19-21May 2022	AECD
Dr. Engr. R. Rashid	International Conference on Electronics and Informatics 2021	BES	27-28 Nov. 2021	AECD
	International Conference on Physics-2022	BPS	19-21May 2022	AECD
Samia Islam Liba	International Conference on Electronics and Informatics 2021	BES	27-28Nov. 2021	AECD
S. I. Liba	International Conference on Physics-2022	BPS	19-21May 2022	AECD
M. R. Hasan	International Conference on Electronics and Informatics 2021	BES	27-28 Nov. 2021	AECD
	International Conference on Physics-2022	BPS	19-21 May 2022	AECD
A. Nahar	International Conference on Electronics and Informatics 2021	BES	27-28 Nov. 2021	AECD
A. Kumar	International Conference on Electronics and Informatics 2021	BES	27-28 Nov. 2021	AECD
	International Conference on Physics-2022	BPS	19-21May 2022	AECD

3. Training Courses and Seminars Organized

Speaker	Title	Date	Place	No. of Participent
M. Dilshad	Incorporation of $CoFe_2O_4$ nanoparticles in Chitosan-PEG scaffold for enhanced wound healing	10Feb. 2022	Materials Science Division	12
S. Hossain	PEGylation of $Mg_xCo_{1-x}Fe_2O_4$ Nanoparticles and their Conjugation with Doxorubicin for a Comparative Study of Drug Loading and Drug Release in Hyperthermia based Anticancer Drug Delivery Process	10 Feb. 2022	Materials Science Division	12
K. Amin	Synthesis of Novel Magnetite Nanoparticles with Chitosaan Mesoporoussilica Coating for efficient	10 Feb. 2022	Materials Science Division	12

Speaker	Title	Date	Place	No. of Participent
	removal of heavy Metals from Wastewater			
T. Hoque	Dextran Coated Magnetic $Co_xMg_{1-x}Fe_2O_4$ Nanoparticles: Study of Drug Release Capacity in Hyperthermia-triggered Anti-Cancer Drug Delivery	10 Feb. 2022	Materials Science Division	12

4. Collaboration Work(s)

- BAN: 02/2 Programme, Supported by Magnetic and Structural Properties of Ferrites, Nanocomposites and Perovskite Materials and biomaterials. International Programme for Physical Science (IPPS) under International Science Programme of Uppsala University, Sweden.

  Project: Structure and Physical Properties study of Advanced and Nano Composite Materials/Biomaterials
- Collaborative research work with different public and private Universities and research organizations.

5. Service Rendered

5.1 Service provided by XRD

Name of the month	Name of Institutions/ Organizations	Name of Samples	No/ of Samples
Aug. 2021	Dept. of Physics, CUET	Powder	1
	Dept. of Physics, BUET	ZnS	1
	Dept. of Physics, BUET	Ferrite	2
	SKF Pharmaceuticals Ltd.	Docetaxel	2
	Dept. of Physics, BUET	Gd, Dy.CrBFO	3
	Dept. of Physics, CoU	$NiZnFe_2O_4$	5
	Dept. of Physics, CoU	$NiZnFe_2O_4$	5
	Dept. of Physics, BUET	Ferrite	5
	Dept. of Physics, BUET	Ribbon	6
Sept. 2021	Dept. of Physics, BUET	Chitosan	3
	SK+F Pharmaceuticals, Ltd	Abemaciclib	1
	Dept. of Physics, BUET	Ferrite	2
	Dept. of Physics, BUET	YNCO	1
	Dept. of Physics, BUET	Ribbon	6
	Dept of MME, BUET	ZnO	2
	Dept of MME, BUET	ZnO	2
	Dept. of Physics DU	Clay	1
	Dept. of Physics, BUET	Activated Carbon	1
	Dept. of GCE, BUET	Powder	1
	SK+F Pharmaceuticals Ltd.	Thin Film	13
	Dept. of Physics, BUET	YNCO	1
	Dept. of Physics, BUET	Thin Film	6
	Dept. of Physics, BUET	Thin Film	6
	Dept. of Physics, BUET	Ferrite	2
	Dept. of Physics, BUET	Powder	1
	Dept. of Physics, BUET	Ferrite	1

Name of the month	Name of Institutions/ Organizations	Name of Samples	No/ of Samples
Oct. 2021	Dept. of Physics, KU	Spinel Ferrite	1
	Dept. of Physics, BUET	$CSSnCl_3$	1
	Premier Cement Mills Ltd.	Cement	1
	Dept of Chemistry, KU	Ferrite	1
	Dept. of Physics, BUET	Ferrite	1
	Dept. of natural Science, NSU	Ferrite	2
Nov. 2021	Dept. of Physics, BUET	Ferrite	2
	Dept. of Physics, BUET	Ferrite	12
	Dept. of GCE, BUET	Ferrite	1
	Dept. of Applied Chemistry, DU	Cu Nano	1
	Dept. of Physics, CU	Powder	2
	Dept. of Physics, Cumilla U	$BaNiFe_2O_4$	1
	Dept. of Physics, BUET	GCr	2
	Dept. of Physics, BUET	Ferrite	2
	Dept. of BSMRMU	Soil	4
	Dept. of MME, BUET	EAF Dust	2
	Dept. of Chemistry, BUET	$NiSiO_2$& SiO_2	2
	Eskayef Pharmaceuticals Limited	Pazopanib&Regorafenib	2
	Dept. of Industrial & Production Engineering, BUTEX	Fiber	1
	Dept. of GCE, BUET	Cement	1
	Dept. of Physics, BUET	Ferrite	3
	Dept. of Leather Engineering, DU	GO	1
	Propriefor J.N. Engineering workshop, 16/2, Bonogram Road, Dhaka	Sand	1
	Eskayef Pharmaceuticals Limited	Medicine	3
Dec. 2021	Dept. of Physics, BUET	Ferrite	1
	Dept. of MME, BUET	CaO Nano	4
	Dept. of GCE, BUET	Cement	1
	Dept. of MME, BUET	Zircon	10
	Dept. of ACCE, DU	Polymer & Plastic	5
	Dept. of BOF	Driving Band	5
	Dept. of GCE, BUET	Cement	1
	SK+F Pharmaceuticals, Ltd.	Docetaxel	1
	SK+F Pharmaceuticals, Ltd.	Olaparib	1
	Dept. of MME, BUET	MnO_2	1
	Dept. of MME, BUET	ZrO_2	1
	Dept. of ACCE, RU	Fe_3O_4	1
	Dept. of Physics, BUET	CuO	1
	Beximco Pharmaceuticals Ltd.	Nirmatrelvir	1
	Dept. of Physics, DU	Poly Cotton	1
	Dept. of Physics, BUET	CuO& MnO_2	2

Name of the month	Name of Institutions/ Organizations	Name of Samples	No/ of Samples
Jan. 2022	Dept. of MME, BUET	CuO	4
	Dept. of MME, BUET	CuO	7
	Dept. of Physics Cumilla University	TiO_2	4
	Dept. of Physics Cumilla University	Ferrite	5
	Dept. of Physics, BUET	Ferrite	2
	Dept. of Physics,DU	Poly Cotton	1
	Dept. of Chemistry, KU	Ferrite	3
	Dept. of GCE, BUET	Cement	1
	Dept. of Physics, BUET	ZnO	1
	Dept. of Physics, BUET	BiNdFeCrO	1
	Dept. of MME, BUET	MoS_2	1
	Dept. of Physics,DU	Ferrite	1
	Dept. of GCE, BUET	Ferrite	1
	Dept. of Physics, BUET	MnO_3	2
	Dept. of Physics, BUET	BiNdFeCrO	1
	Dept. of Chemistry, KU	Spinel Ferrite	1
	Dept. of Chemistry, KU	GO	1
	Dept. of Chemistry, KU	ZnO	2
	Dept. of Physics, DU	NiZnCd Ferrite	4
	Dept. of CE, BUET	TiO2	4
	Dept. of Physics, BUET	Thin Film	3
	Dept. of Chemistry, BUET	Ni- Nano Particle	1
	Dept. of MME, BUET	Ce_2FeCrO_6	1
	SK+F Pharmaceuticals Ltd.	Ritonavir	2
	SK+F Pharmaceuticals Ltd.	Ritonavir	2
	Dept. of Physics, DU	$LiCuZnFe_2O_4$	1
	Beximco Pharmaceuticals Ltd.	Medicine	1
	Dept. of GCE,BUET	Cement	1
Feb. 2022	Dept. of Chemistry, BUET	RGO.ZifMnO_2	1
	Dept. of Chemistry, BUET	RGO	2
	Dept. of Chemistry, KU	Ferrite	1
	ACIL, Pharmaplant	Ritonavir, USPS Nirmatrelvir-INN	3
	Dept. of NSU	Ferrite	4
	Dept. of Chemistry, KU	Ferrite	1
	Dept. of Chemistry, BUET	Fe_2O_3& Ni Nano Particle	2
	Dept. of Physics, DU	Thin Film	1
	Dept. of Physics, BUET	Thin Film	1
	Sk+F Pharmaceuticals Ltd.	Olaparib	2
	Dept. of MME, BUET	TiO_2	6
	Dept. of MME, BUET	Ferrite	2
	Beximco Pharmaceuticals Ltd.	Ritonavir	4

Name of the month	Name of Institutions/ Organizations	Name of Samples	No/ of Samples
	Sk+F Pharmaceuticals Ltd.	Olaparib	1
	Dept. of Chemistry, RU	Nanomaterials	3
	Dept. of Chemistry, RU	Nanomaterials	2
	Dept. of MME, BUET	ZnO Co doped	3
	Dept. of Physics, BUET	BiNdFeCrO	2
Mar. 2022	Dept. of Chemistry, KU	GO+RGO	4
	Dept. of Chemistry, BUET	GO+RGO	2
	Dept. of Physics, DU	ZnO	1
	Dept. of GEC, BUET	Cement	2
	Dept. of Chemistry, BUET	Carbon Supported Ni	1
	Dept. of Physics, BUET	Hybrid Thin Film	4
	Dept. of Chemical Engineering, BUET	Jute	1
	Dept. of Physics, BUET	Ferrite	1
	Dept. of Chemistry, BUET	Al_2O_3	2
	Dept. of MME, BUET	Thin Film	4
	SK+F Pharmaceuticals Ltd.	Abemaciclib	1
	Dept. of Textile Engineering, BGMEA	Fiber	1
	Dept. of Physics, BUET	$CsSnBr_3$	1
	Dept. of Physics, BUET	Y_2MCrO_6	2
	Dept. of Physics, BUET	$CsSnBr_3$	1
	Dept. of MME, BUET	CuO	1
	Dept. of Chemistry, RU	Nano Materials	1
	Dept. of Physics, PUST	Thin Film	1
	Dept. of Physics, BU	Graphen	1
	Dept. of Physics, BU	ZnO	1
	Dept. of Chemistry, BUET	MnO_2	4
	Dept. of GCE, BUET	Cement	1
	Dept. of MME, BUET	CuO	1
	Dept. of Physics, BU	Pbs Nanoparticle	1
	Dept. of CEE, SUST	Clay	1
	Dept. of MME, BUET	CuO	1
Apr. 2022	Dept. of Chemistry, BUET	Polymer	1
	Dept. of Chemistry, JNU	CuO	4
	Dept. of Chemistry, BUET	ATAC&HFAC	2
	Dept. of Physics, BUET	Ferrite	-
	Dept. of Textile Engineering, BGMEA	CMC	1
	Dept. of MME, BUET	CuO	5
	Dept. of Physics, BU	Thin Film	2
	Dept. of Physics, BU	Ni doped ZnSeNanoParticle	1
	Dept. of Physics, BUET	Polymer	2
	Dept. of Textile Engineering, BGMEA	Fiber	1

Name of the month	Name of Institutions/ Organizations	Name of Samples	No/ of Samples
	Latif Bayan Jute Mill, Demra	CNC	1
	Dept. of Textile Engineering, BGMEA	Fiber	1
	Dept. of Physics, BU	Gr-Epoxy	3
	Dept. of Physics, RU	$LaPbMnO_3$	2
	Dept. of Physics, BU	Co doped ZnO	1
	Dept. of MME, BUET	EAF DUST	7
	Dept. of MME, BUET	N doped CuO	3
	Dept. of Chamistry, JNU	CuO	1
	River Reasher Institute	Soil	24
	Dept. of Chamistry, BUET	Cu impregnated with Zeo Lite	1
	Dept. of Chemistry, KU	GO	2
	EkF Pharmaceuticals Ltd.	VCG	1
May 2022	Dept. of Textile Engineering, KUET	Cellulose	2
	Dept. of GCE, BUET	Cement	1
	Dept. of Textile Engineering, KUET	100% Cotton Woven Fabric	1
	Dept. of Physics, BUET	Thin Film	3
	Dept. of Chemistry, BUET	SnO_2	2
	Dept. of M.E., DUET	Al+SiC	1
	Dept. of Physics, BUET	MoS_2	4
	Dept. of Chemistry, DU	Fe_3O_4 Nano Particle	2
Jun. 2022	Dept. of Physics, BUET	$BiLaFe_3O_4$	1
	Dept. of Physics, BUET	ZnS Thin Film	1
	EkF Pharmaceuticals Ltd.	Docetaxel Trihydrate	1
	Dept. of ACCE, DU	Scaffold	4
	Dept. of ME, DUET	$CaOH_2$& $Ca(NO_3)_2H$	2
	Dept. of Physics, BUET	ZnS Thin Film	1
	Dept. of Chemistry, BUET	SnO_2	2
	Dept. of Chemistry, RU	Powder	13
	Dept. of Chemistry, RU	Polymer	2
	Dept. of MME, BUET	EAF DUST	9
	Dept. of BME, MIST	HAP	1
	Dept. of Pharmacy, DU	Powder	4
	Dept. of Chemistry, BUET	$NiNb_2O_5$	2
	Eskayef Pharmaceuticals Ltd.	Vericiguate	1
	Dept. of Chemistry, KU	GOI-Cu_2O	1
	Dept. of TE, JUST	Nano Cellulose	3
	Dept. of Physics, BUET	Silver –PVA Nano Composite	1
	Dept. of MME, BUET	TiO_2	1
	Dept. of Chemistry, JNU	TiO_2	5
	Beximco Pharmaceutical Ltd.	Rosuvastatin Calcium	2
Total			132

5.2 Service Provided by SEM and EDAX

Name of the Month	Name of Institutions/ Organizations	Name of Samples	Number of Samples
Apr. 2022	Dept. of Chemistry, DU	Micro Plastic	5
Jun. 2022	Dept. of Textile Engineering, BUET	Cupro, Acitate,Viscope	4
	Dept. of CEE, SUST	Clay Materials	6
	Dept. of BPDB	Regin	2
	Dept. of Chemistry BUET	Nano Particle	3
	Dept. of GCE, BUET	Soil	1
Total			21

5.3 Service Provided by TEM

Name of the month	Name of Institutions/Organizations	Name of Samples	No. of Samples
Sept. 2021	Dept. of Physics, BUET	FeMgO-RGO	1
	Dept. of Physics, BUET	ZnO	2
	Dept. of Chemistry, JNU	CuO(H), CuO (P)	2
	Dept. of GCE, BUET	Rice Husk	1
Oct. 2021	Dept. of GCE, BUET	BVO NPs	3
	Dept. of BCSIR	$CoFe_2O_4$ NPs	1
Nov. 2021	Dept. of Physics, BUET	ZnO NPs	1
	Dept. of Chemical Engineering, SUST	TiO_2 NPs	1
	Dept. of BSMRMU	ZnO NPs	4
	Dept. of Chemistry, SUST	Ferrite	1
	Dept. of Chemistry,DU	TiO_2ZnO NPs	1
Dec. 2021	Dept. of Mathematics &Physics, NSU	NiCuAl Ferrite NPs	1
Jan. 2022	Dept. of Physics, BUTEX	ZnO, ZnOGP, ZnOAgGp NPs	4
	Dept. of JNU	ZnO, N-ZnO, ZnO-AC &SnO-AC NPs	4
Feb. 2022	Dept. of MME, BUET	Uncoted& Silica Coted magnetite NPs	2
	Dept. of ChE, JUST,	Dhainchya Fiber NPs	1
	Dept. of Pharmaceuticals Scienc,NSU	Liposome Drug NPs	1
Mar. 2022	Dept. of MME, BUET	CuO NPs	2
	Dept. of BCSIR, Dhaka	Nano Particle	3
	Dept. of Chemistry, Comilla University	NanoParticals	1
Apr. 2022	Dept. of Chemistry, DU	Nano Particals	3
	Dept. of Chemistry, SUST	Nano Particals	1
May 2022	Dept. of Chemistry, Comilla University	CoONanoParticle	2
	Dept. of Chemistry, DU	Graphine Oxide	2
Jun. 2022	Dept. of Chemistry, DU	Zn, Ag, TiNPs	4
	Dept. of Chemistry, JNU	CuO	3
	Dept. of CEP, SUST	Zn, TiONPs	2
	Dept. of TE, JUST	Nano Celulose& Nano Particles	3
	Dept. of MME, BUET	MoS_2 Nano Particles	1
	Dept. of Pharmacy, JU	Powder	8
Total			66

5.4 Service Provided by Raman Spectroscopy

Name of the month	Name of Institutions/Organizations	Name of Samples	No. of Sample
Sept. 2021	Dept. of Physics, BUET	Thin Film	1
Nov. 2021	Dept. of Chemistry, JNU	Graphine Oxide	1
	Dept. of LE, DU	Graphine Oxide	1
	Dept. of Physics, BUET	$BiFeO_3$(doped)	12
Dec. 2021	Dept. of BOF	Driving Band	5
Feb. 2022	Dept. of Chemistry,BUET	RGO	2
Mar. 2022	Dept. of LE, DU	GO Composite	2
	Dept. of MME, BUET	MoS_2,$2MnO_2$,$4MnO_2$, $6MnO_2$	4
	Dept. of Physics, BUET	$YeFeCrO_6$	1
Apr. 2022	Dept. of Chemistry, BUET	Activated Carbon	2
	Dept. of ACCE,DU	MGO and GO	2
May 2022	Dept. of Physics, BUET	MnO_2NiOCoO Nano Composite	5
Jun. 2022	Dept. of Physics, BUET	MoS_2	3
Total			41

5.5 Service Provided by PPMS

Name of the month	Name of Institutions/Organizations	Name of Samples	No. of Samples
Sept. 2021	Dept. of BIRI,BCSIR	Ferrite	7
	Dept. of Physics, BUET	ZnO	2
Oct. 2021	Dept. of Physics, RU	Ferrite	2
	Dept. of Cumilla University	Ferrite	5
	Dept. of Cumilla University	Ferrite	5
Nov. 2021	Dept. of BUTEX	Ferrite	6
	Dept of Chemistry, KU	Ferrite	3
	Dept. of Physics, BUET	Ferrite	5
Dec. 2021	Dept. of Physics, BUET	Li-Cu-Mg Ferrites	4
	Dept. of Physics, BUET	Cu Iron Nano Powder	4
	Dept. of Physics, BUET	MgCuZn Ferrite	2
	Dept. of Physics, BUET	MgCuZn Ferrite	2
Jan. 2022	Dept. of ACCE, DU	Ferrite	3
	Dept. of NSU	Ferrite	13
	Dept. of Physics, BUET	$Re_{1-x}Sr_xMnO_3$	3
Feb. 2022	Dept. of NSU	Ferrite	5
	Dept. of KUET	Cellulose Fe_2O_3	3
	Dept. of Physics, DU	LiCuZn Ferrite	5
	Dept. of Physics, DU	LiZnCd Ferrite	4
	Dept. of Physics, DU	LiCuZn Ferrite	5
	Dept. of Physics, DU	Ferrite	3
Mar. 2022	Dept. of Physics, RU	SiO_2/Ni/PPY SiO_2/Ni-EDA	2
	Dept. of CU	MS	8

Name of the month	Name of Institutions/Organizations	Name of Samples	No. of Samples
	Dept. of Physics, BUET	LiZnCd Ferrite	4
	Dept. of Physics, BUET	NiZnCd	4
	Dept. of Physics, BUET	ZFC-FC	3
Total			112

5.6 Service Provided by DSC/TGA

Name of the month	Name of Institutions/ Organizations	Name of Samples	No. of Samples
Sept. 2020	Dept. of Physics, BUET	Chitosan	3
Oct. 2021	Dept. of Mechanical Engineering, CUET	Polymer and Fiber	3
	Premier Cement Mills Ltd.	Cement	1
Nov. 2021	Dept. of ACCE, DU	Chitosan & PVA/CS	3
	Dept. of ACCE, DU	H-01,H-02,H-03,H-04	4
	Dept. of ACCE, DU	CuO Loaded PVA/CS mat	3
	JN Engineering Workshop	Sand	1
Dec. 2021	Dept. of ACCE, DU	T-1,T-2,T-3, T-4, T-5, T-6	6
	Dept. of BOF	Driving Band	5
Jan. 2022	Dept. of ACCE, BUET	Ferrite	3
	Dept. of Chemistry, BUET	TPA	3
Feb. 2022	Dept. of MME, BUET	Alloy	8
	Dept. of Chemical Engineering, JUST	DPM Composite	1
Mar. 2022	Dept. of Chemistry, JU	Nano Materials	7
Apr. 2022	Dept. of MME, BUET	Alloy	2
	Dept. of Textile Engineering, BGMEA	Fiber	1
	Dept. of Textile Engineering, BGMEA	Viscose Fiber	1
May 2022	Dept. of ACCE, DU	Espun Fiber, ASc & Polymer	3
	Dept. of Physics, KUET	Fabric	1
	Dept. of BGMEA, University	Cotton	1
	Dept. of Textile Engineering, BGMEA	Cigarette	1
Jun. 2022	Dept. of TE, JUST	Cellulose	3
	Dept. of DU	Antibiotic	2
	Dept. of ACCE, DU	Pd- mat	1
Total			67

5.7 Service Provided by DLS Zeta Potemtial

Name of the month	Name of Institutions/Organizations	Name of Samples	No. of Samples
Oct. 2021	Dept. of A.C., DU	Cu Nano	1
Nov. 2021	Dept. of Applied Chemistry, DU	Cu Nano	1
	Dept. of Pharmacy, NSU	Cholestrol,NIR,PBS	8
	Dept. of LE, DU	Graphine Oxide	5
Dec. 2021	Dept. of Chemistry, DU	ZnO	1

Name of the month	Name of Institutions/Organizations	Name of Samples	No. of Samples
Jan. 2022	Dept. of Chemistry, RU	Ag.ZnO, Cellulose	3
	Dept. Pharmacy, NSU	PBS Buffer	8
Mar. 2022	Dept. of EEE, IU	$AgNO_3$	5
Apr. 2022	Dept. of A.C., DU	Graphine Oxide	5
	Dept. of DU	Nano Crystal	1
May 2022	Dept. of ACCE, DU	GOSi	2
	Dept. of DUET	Brophne	6
Jun. 2022	Dept. of ACCE, DU	Chitosan Alginate Nano	1
	Dept. of ACCE, DU	Chitosan Alginate Nano, PEG	2
	Dept. of Pharmaceuticals Chemistry, DU	Cellulose Nano Crystal	2
	Dept. of Chemistry, DU	Silver Nano	2
	Dept. of ACCE, DU	Chitisan	1
	Dept. of TE, JUST	Nano Cellulose	4
	Dept. of Chemistry, JNU	CuO	3
Total			61

5.8 Service Provided by FTIR

Name of the month	Name of Institutions/ Organizations	Name of Samples	No. of Samples
Aug. 2021	Dept. of Physics, BUET.	LiZnFe2O4	4
Sept. 2021	Dept. of Physics, DU	AL	1
Oct. 2021	Dept. of Mechanical Engineering, IUBAT	Leaf Powder	4
	Dept. of Mechanical Engineering, IUBAT	PPT and Leaf Powder	2
	Dept. of Mechanical Engineering, IUBAT	PPT	1
Nov. 2021	Dept. of Physics, BUET	Ferrite	4
	Dept. of Industrial & Production Engineering, BUTEX	Fiber	1
	Dept. of Physics, BUET	LiCoMg Ferrite	4
	Dept. of IUBAT	Leaf Extract	2
	Dept. of Physics, BUET.	$BiFeO_3$	5
	Dept. of BSME,IUBAT	Leaf Extract Powder	1
Dec. 2021	Dept. of BOF	Driving Band	5
	Dept. of Physics, BUET	Doped $BiFeO_3$	2
	Dept. of Physics, DUET	Graphine	1
	Dept. of Physics, RU	Cellulose	6
	Bangladesh University of Textile (BUTEX)	Yarn	1
	Dept. of Physics, BUET	$CsSnCl_3$	13
Jan. 2022	Dept. of Physics, BUET	Ferrite	3
	Dept. of Physics, BUET	Ferrite	5

Name of the month	Name of Institutions/ Organizations	Name of Samples	No. of Samples
	Dept. of CE, BUET	TiO_2	4
	Dept. of Physics, DU	Ferrite	4
	Dept. of Physics, DU	$LiCuZnFe_2O_3$	5
	Dept. of Microbiology, DU	Violacein Pigment	1
Feb. 2022	Dept. of BSME, IUBAT	MS	1
	Dept. of BSME, IUBAT	Flower Extract	1
	Dept. of Physics, SUST	Ferrite	1
	Dept. of Physics, SUST	MS	1
	Dept. of NSU	Liposomal Drug	1
Mar. 2022	Dept. of Physics, DU	ZnO	6
	Dept. of BSME, IUBAT	Ferrite	1
	Dept. of Physics, BUET	LiCrZn Ferrite	2
	Dept. of EEE, IU	Allium Cepa	5
Apr. 2022	Dept. of Chemistry, Comilla University	Cobult Oxide	2
Jun. 2022	Dept. of NSU	Gel	3
	Dept. of Chemistry, RU	Powder	1
	Dept. of Physics, BUET	ZnS Thin Film	1
	Dept. of Chemistry, KU	GOI-Cu_2O Thin Film	1
	Dept. of Noakhali Science & Technology	Powder	1
Total			107

5.9 Service Provided by UV

Name of the month	Name of Institutions/Organizations	Name of Samples	No. of Samples
Sept. 2021	Dept. of Physics, BUET	Thin Film	4
	Dept. of Physics, BUET	Thin Film	4
Oct. 2021	Dept. of Mechanical, IUBAT	Leaf Powder	4
Total			12

Medical Physics Division, AECD

Objective/Introduction

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

Programme

- 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 Evaluation of Dosimetric Errors of TPS Calculations for Lung Doses in 3D-CRT & IMRT Using CIRS Thorax Phantom

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

Objective: Discrepancies of lung doses of TPS calculated dose & measured dose in 3D conformal radiation therapy (3D-CRT) & intensity modulated radiation therapy (IMRT) modalities using anthropomorphic CIRS thorax phantom (Model 002LFC).

Current Progress**:** This experiment with anthropomorphic phantom shows that TPS calculation for lung doses is not accurate and maximum deviation was 4.652%.Thus discrepancy in between calculated dose & measured dose should not exceed ICRU recommendation in order to execute an accurate dose within the volume in treatment plan, otherwise it shows inaccuracy of the algorithm of TPS. Further study is in progress.

* Gono Bishwabidyalay, Savar, Dhaka, Bangladesh

1.2 Commissioning of Radiotherapy Treatment Planning System using CIRS Thorax Phantom: Optimization of the Dosimetric Test of the IAEA TECDOC-1583 Guidelines

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

Objective: Commissioning of radiotherapy treatment planning system (RTPS) using the IMRT thorax phantom (CIRS - 002LFC) and investigate the deviation in between the calculated dose and measured dose distribution in the phantom.

Current Progress: The measured and calculated doses for seven cases were obtained. The maximum deviation was 42.74% for lung case. Whereas according to IAEA TECDOC-1583, deviation should be within 4%. The causes of such incongruity may be due to the exact placement of ionization chamber in the phantom or air gap outside the chamber. Other problems may be occurred due to the scattered dose, field converse or field size, effective point of measurement of ionization chamber in a phantom.

* Gono Bishwabidyalay, Savar, Dhaka, Bangladesh

1.3 Dosimetry Measurement of Medical Linear Accelerator with ID Water Phantom and Solid Water Phantom and Assessment the Authentication of it with Machine Data

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

Objective: Absolute dosimetry of medical linear accelerator with 1D water phantom and solid Water phantom and finally shows the verifications of it with machine data.

Current Progress: The measurements were conducted using Varian Clinac iX at the Institute of Nuclear Medical Physics, Bangladesh Atomic Energy Commission. The machine was tuned to deliver 1cGy/MU at SSD technique at D_{max} for all the available photon energies and kept as a baseline. All the measurements were carried out using the IBA 1D water phantom and Solid Water Phantom with farmer 0.65 cc (FC 65-P) chamber. Absorbed dose to water at the depth of dose maximum (Zmax) for 1D Water Phantom and Solid Water phantom for 6MV and 15MV Photon Beam was measured. For 1 D Water phantom, a variation with machine data was obtained as 0.9% and 1.77% for 6 MV and 15 MV photon beam respectively. For Solid Water phantom, a variation with machine data was obtained as 0.3% and 0.35% for 6 MV and 15 MV photon beam respectively. The beam quality parameters of the available photon beams were found to be Varian acceptance tolerance and also compatible with the IAEA TRS 398 recommendations.

1.4 Evaluation of Radiation Dose in Computed Tomography Using Computed Tomography Dose Index (CTDI) phantom

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

Objective: To verify the CT Dose Index (CTDI) obtained from the CT scanner console by measuring the dose in the acrylic phantoms for each CT scanner which is required during acceptance and constancy checks of CT system.

Current Progress: The CTDI is a simple, standardized measure of the dose output of a CT scanner that can be used to compare different scan techniques on a single scanner or between scanners. 3-part PMMA CT-

Phantom are (1) Adult Body Phantom (32 cm diameter, 4 holes) (2) Adult Head / Pediatric Body Phantom (16 cm diameter, 4 holes) and (3) Pediatric Head Phantom: (10 cm diameter, 5 holes) and 13 acrylic rods for plugging all the phantom holes. It also has DCT10-MM Ionization chambers for CT and MagicMax Universal which was used to collect the charge. $CTDI_{100}$ for the three phantoms were measured using Ionization chamber and the data were collected with MagicMax Universal. $CTDI_{VOL}$ were calculated for the three phantoms by using $CTDI_{100,}$ $CTDI_W$ and Pitch factor. The calculated CTDI were complied with the console value within a tolerance of ± 20 %.

1.5 A Comparison Study of Photon Beam using Water Phantom and Solid Phantom with Depth Variation

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

Objective: A comparison study of photon beam using water phantom and a solid phantom shows a very little difference in charge measurement but huge time-difference during the experimental set-up and hence, in charge measurement.

Current Progress: This study was carried out with a ionization chamber (model: FC65-P), 1D water phantom, solid phantom (SP34) and an electrometer. Ionization chamber placed in water phantom and solid phantom, irradiated by 6 MV and 15 MV photon beam from linac (clinic iX) at INMP, Savar. All the arrangement was made in treatment room with the vertical direction to the radiation beam of phantom where ionization chamber is placed for collecting beam current. Each time a 100 MU beam is delivered to the ionization chamber at each depth, repeated for five times to make an average, with 10 x 10 cm^2 field size. An electrometer is placed at linac console room, used for charge measurement. During this study, chamber is placed at 1 -10 cm distance at each phantom respectively. Measurement of charge (in nC) using electrometer with 6 MV Photon beam: 21.08, 22.19, 21.7, 21.12, 20.5, 19.86, 19.24, 18.59, 17.94, 17.28 (in water phantom) & 20.94, 22.14, 21.64, 21.02, 20.42, 19.77, 19.11, 18.46, 17.81, 17.13 (in solid phantom). Measurement of charge (in nC) using electrometer with 15 MV Photon 17.89, 22.2, 23.2, 23.2, 22.82, 22.36, 21.87, 21.36, 20.85, 20.31(in water Phantom) & 17.47, 21.81, 22.84, 22.83, 22.47, 22.01, 21.5, 20.99, 20.59, 19.8 (in solid phantom). This experiment ensures solid phantom is a good choice for quick check of in case of time consideration.

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

Name of the participant	Title of the event	Organizer	Date	Place
R. Khatu	International Conference on Physics-2022	BPS	19-21 May 2022	AECD
	National Conference on Society of Nuclear Medicine Bangladeah	SNMB	20 May 2022	BICC, Dhaka
S. Akter	International Conference on Physics-2022	BPS	19-21 May 2022	AECD
	National Conference on Society of Nuclear Medicine Bangladeah	SNMB	20 May 2022	BICC, Dhaka
	International Conference on Physics in Medicine	BMPA, BAEC	26-27 May 2922	AECD
	Evaluation of Radiation Dose in Computed Tomography Using CTDI phantom	AECD	06 Jun. 2022	AECD
A. N. Monika	International Conference on Physics-2022	BPS	19-21 May 2022	AECD
	National Conference on Society of Nuclear Medicine Bangladeah	SNMB	20 May 2022	BICC, Dhaka
	International Conference on Physics in Medicine	BMPA, BAEC	26-27 May 2922	AECD
	A comparison study of photon charge between water phantom and solid phantom with depth variation	AECD	25 May 2022	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.

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 , K. Alam, M.A.M. Islam and R. Pritom

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

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

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

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

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

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

1.3 Development of Eddy Current Testing Technique for Heat Exchanger Tube

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

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

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

1.4 Digital Industrial Radiographic Method for Industrial Practices

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

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

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

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

Name of the person	Title of the event	Organizer	Date	Place
S. C. Dey	Regional Training Course (RTC) on "Computed Tomography (CT) in Associated with 3D Image Analysis for Industrial Components"	IAEA	06 – 10 Sept. 2021	Virtual Platform
K. Alam	Regional Training Course (RTC) on "Computed Tomography (CT) in Associated with 3D Image Analysis for Industrial Components"	IAEA	06 – 10 Sept. 2021	Virtual Platform
R. Pritom	Regional Workshop on "NDT in Civil Engineering Structures during maintenance and post disaster"	IAEA	26 - 29 Jul. 2021	Virtual Platform

3. Collaboration Work(s)

3.1 IAEA Projects

NDT Division has been actively participating in all IAEA/RCA Programmes 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)".

3.2 NDT Training

- During this reporting period, the concerned persons of the NDT Division delivered theoretical lectures on different NDT methods from 13 – 14 Sept. 2021 to the 66th 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 & Biman Bangladesh Airlines, 1 participant each from Nigerian Air force & Srilanka Air Force were present in this course. The NDT Division also conducted day long practical demonstration class on 15 Sept. 2021 for the above course. This collaboration is likely to be continued.
- During this reporting period, the concerned persons of the NDT Division delivered theoretical lectures on different NDT methods on 30 Jan. 2022 to the 67th 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, 1 participant each from Nigerian Air force, Pakistan Air Force & Srilanka Air Force was present in this course. This collaboration is likely to be continued.

4. Academic

4.1 Practical Demonstration for University Students

Within this reporting period, NDT Division of BAEC arranged Practical Session on different NDT methods to the programme "Industrial Training Session" for 38 students of Level – 3/Term – 2 of Department of Nuclear Science and Engineering, Military Institute of Science and Technology (MIST) from 13 – 20 Mar. 2022 to provide application based knowledge on NDT methods as a part of their curriculum activities.

4.2 Internship Programme on Industrial Training for University Students

BAEC has collaboration with different universities to extend R & D programme to attain sustainability and to promote technology in the country. Within this reporting period NDT Division of BAEC has conducted two weeks long Internship Programme on Industrial Training as a part of the curriculum activities for 2 B.Sc. students of 3rd year, Department of Nuclear Engineering, University of Dhaka from 12 – 22 Dec. 2021 to provide familiarization and application based knowledge on NDT methods.

5. Service Rendered and Revenue Income

Name of service given to the organization	Nature of service	No. of service	Revenue income
Active NDT Services	Calibration of Ultrasonic Thickness Gauge	1	2,000/-
Safe Naval Architects & Marine Consultants	Calibration of Ultrasonic Thickness Gauge	1	2,000/-
6 times to BITAC, Dhaka	Ultrasonic Testing of Journal Bearing	6 (6 times)	17,760/-
Bay-Tech NDT & Engineering Services	Calibration of Ultrasonic Thickness Gauge	1	2,000/-
Marine NDT & Engineering Works	Calibration of Permanent Magnetic Yoke Calibration of Ultrasonic Thickness Gauge	1 2	6,000/-
Deya Oil Ltd	Calibration of Ultrasonic Thickness Gauge	1	2,000/-
Innovative Engineering Services	Calibration of Ultrasonic Thickness Gauge	2	4,000/-
PEB Steel Alliance LTD	Calibration of Ultrasonic Flaw Detector Calibration of Ultrasonic Thickness Gauge	1 1	5,000/-
Bangladesh Industrial X-ray	Calibration of Ultrasonic Flaw Detector Calibration of Electromagnetic Hand Yoke Calibration of Ultrasonic Thickness Gauge Calibration of IR Film Densitometer Calibration of Light Meter Calibration of Lux Meter	3 7 2 3 1 1	32,000/-
Solutions NDT & Inspection Services	Calibration of Ultrasonic Flaw Detector Calibration of Electromagnetic Hand Yoke	1 1	5,000/-
Basundhara Steel & Engineering Ltd.	Calibration of Ultrasonic Flaw Detector Calibration of Ultrasonic Thickness Gauge	1 1	5,000/-
9 times to Ghorasal Polash Urea Fertilizer Project	Consulting Service on NDT	17 man month	5,42,500/-
Confidence Steel Limited	Calibration of Ultrasonic Flaw Detector	1	3,000/-
Modern Steel Engineering	Ultrasonic Testing of shaft of North Bengal Sugar Mills Ltd. & Thakurgaon Sugar Mills Ltd.	2	11,740/-
Saj Engineering & Trading Company	Magnetic Particle Testing of Turbines (GT of Model: 2000E, Siemens) of Northwest Power Generation Company Ltd.	6 man day	2,58,425/-

Name of service given to the organization	Nature of service	No. of service	Revenue income
Sahara Corporation	Industrial Videoscope Inspection of Gas Turbine of Unit-2 of Shiddhirganj Powerplant, EGCB Ltd., Shiddhirganj, Narayanganj	6 man day	70,000/-
Marine Inspection & Solutions Ltd	Calibration of Ultrasonic Thickness Gauge	1	2,000/-
Quality Industrial NDT Service & Training Centre(QISTC)	Calibration of Ultrasonic Flaw Detector	1	3,000/-
Industrial Engineering Services	Calibration of Ultrasonic Flaw Detector Calibration of Electromagnetic Hand Yoke	2 2	10,000/-
Radiant Engineering Training Services and Inspection Ltd	Calibration of Ultrasonic Flaw Detector Calibration of Ultrasonic Thickness Gauge Calibration of Electromagnetic Hand Yoke	2 1 2	12,000/-
Western Marine Services Ltd	Calibration of Ultrasonic Flaw Detector Calibration of Ultrasonic Thickness Gauge	1 1	5,000/-
Rifat Enterprise	Calibration of Ultrasonic Thickness Gauge	2	4,000/-
NDE Steel Structures Ltd	Calibration of Ultrasonic Thickness Gauge Calibration of Electromagnetic Hand Yoke Calibration of UV Black Light System	1 1 1	5,000/-
Military Institute of Science & Technology	Arrangement of Practical Session on NDT	5 days	25,000/-
Fresh Marine	Calibration of Ultrasonic Thickness Gauge	1	2,000/-
Energy China NEPC	Calibration of Ultrasonic Flaw Detector	1	3,000/-
2 times to M/S Belal & Brothers	Ultrasonic Testing of Welding Joints of I-beam of Steel Truss of Amusement Park at Banani-27, Dhaka under Dhaka North City Corporation	16	10,000/-
Waterline Ship Design & Consultant and Fleet Marine Services	Calibration of Ultrasonic Thickness Gauge	2	4,000/-
Total			10,53,425/-

6. Inspection of the Manufacturing of LTME for The Construction of Rooppur Nuclear Power Plant

Rooppur Nuclear Power Plant (RNPP), the first nuclear power plant of Bangladesh is being constructed by the Government of the People's Republic of Bangladesh at Rooppur, Pabna in collaboration with Russian Federation. To control & maintain the quality & assure safety of nuclear power plant equipment, it is required to use NDT applications in all stages of manufacturing & installation processes for the uninterrupted operation of the Plant. Considering the demands of the RNPP project NDT Division has been involved to ensure safety, reliability & integrity of the power plant. As the requirement of RNPP project the following experts of NDT Division were deployed at various Nuclear Power Plant Equipment Manufacturing Plants located at different region of Russian Federation to attend the Inspection of the Manufacturing of LTME for the construction of Rooppur Nuclear Power Plant:

- Mr. Md. Faruque Hossain Chowdhury, 25 Aug. 2020 –30 Nov. 2021, Petrozavodsk & Saint Petersburg, Russia
- Mr. Md. Saiful Alam, 25 Aug. 2020 –05 Feb. 2022, Volgadonsk, Rostov, Russia

- Mr. Md Ahasanul Habib, 25 May 2021 – 31 Nov. 2021, Petrozavodsk, Russia

7. Monitoring of NDT Work of Welding Joints of Safety Class1, 2&3 Equipment at RNPP Site

Four experts of NDT Division have been deputed by Bangladesh Atomic Energy Commission at Construction of Rooppur Nuclear Power Plant Project Site to monitor the NDT (RT, UT & PT) related work in order to control the quality of welding joints in significant equipment (Tank, Steam Generator, Reactor Pressure Vessel) and Main Coolant Pipe Lines of 14 Systems having various category of Safety Class 1, 2, 3. Two experts from NDT Division at a time completed the duties during the period from Jan.-Feb. 2022 sequentially and by rotation as per scheduled roster.

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 enrich & operate the 'Gamma Spectroscopy System', detection & analysis of radionuclides in different specimens and the health risks assessment.

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 environmental, 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 with other associated 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.

1. Research and Development Work(s)

1.1 Operation and management of the 3 MV VDG Accelerator and Gamma Spectrometry System

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

Objective: The main objective is to keep the accelerator operational, to produce and accelerate the proton beam for research purpose. Sampling, detection & analysis of radiological substances by 'Gamma data acquisition setup'.

Current progress: Sampling, experiments, detection& analysis of radiological substances accumulated in different specimens collected from coalmine & waterfall areas, imported & locally produced powder milk, & vegetable samples from local market using 'Gamma data acquisition setup' of Accelerator Laboratory of AECD. 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 foodstuffs 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.

1.2 Radionuclides Detection, Analysis and Pollution Level Assessment of soil of Cox's Bazar Sea Beach area

J. Abedin, Y. N. Jolly and A. Rahman*

Objective: To detect and analyze the radiological substances accumulated in Cox's Bazar Sea Beach area and the evaluation of their impacts on the environment as well as on living beings.

Current progress: A number of soil samples were collected, processed & taken under gamma experiments for the detection of radiological substances accumulated somehow. Cox's Bazar Sea Beach is a tourist crowded place, probability of radiological contamination is risky for the visitors. The collected soil samples were 1Kg each. Each of the samples was taken under gamma experiments about 19687 seconds for data acquisition. The gamma energies emitted from the radionuclides present in samples were detected by the HPGe detector,

amplified and processed by MCA unit. Data acquisition and spectrum analysis were done according to the energy lines of different radionuclides by Genie-2000 software. The detected and analyzed energy lines of different radionuclides and the results of one of the soil samples is projected here;

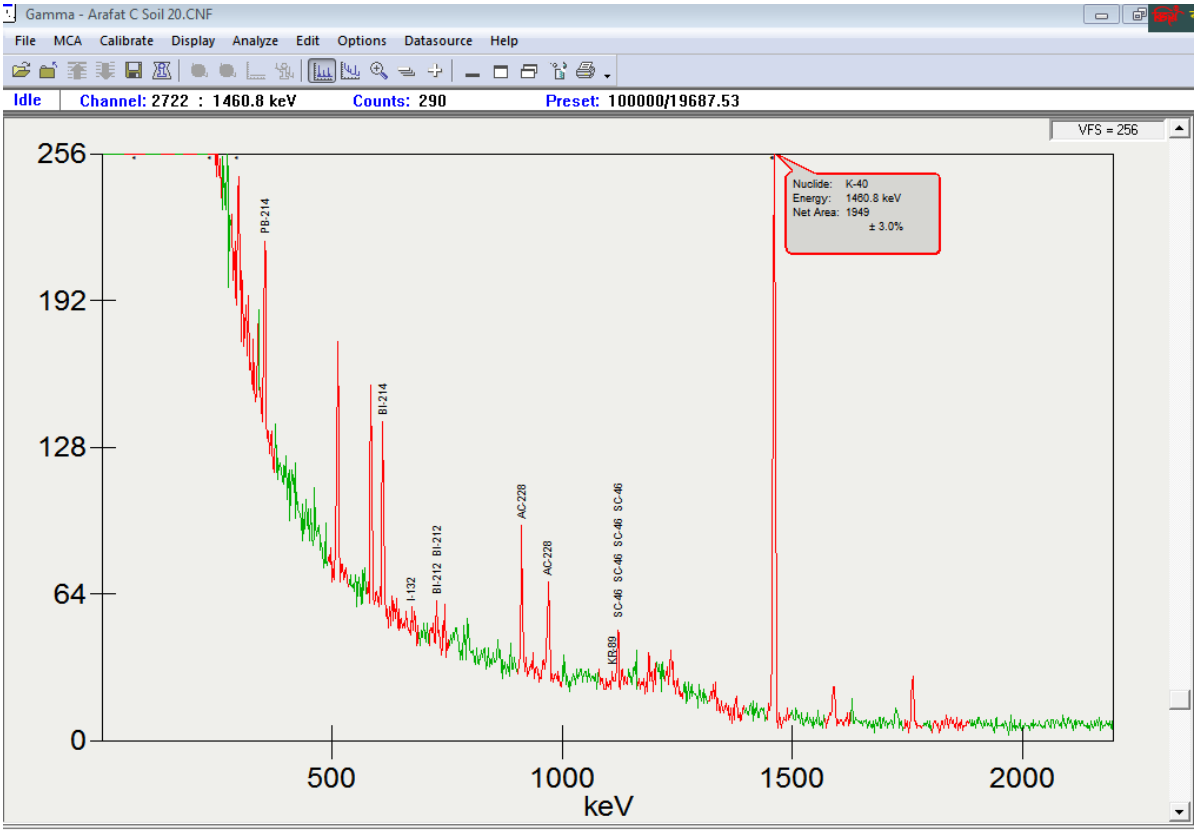

Fig: Analyzed Spectrum of one of the Soil samples (Cox's Bazar)

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

Sample Title: Radionuclide Detection

Sample Identification: Soil Cox's B. 20

Peak No.	ROI start	ROI end	Peak centroid	Energy (keV)	FWHM (keV)	Net Peak Area	Net Area Uncert.	Continuum Counts
1	116-	173	137.56	73.83	4.58	1.868E+03	111.80	1.403E+04
2	116-	173	158.23	84.92	4.65	1.021E+03	101.71	1.488E+04
3	328-	358	345.56	185.45	1.60	4.680E+02	253.22	1.305E+04
4	430-	462	444.21	238.39	3.09	1.399E+03	220.46	9.197E+03
5	539-	568	550.11	295.23	2.28	4.680E+02	160.54	5.324E+03
6	618-	669	628.93	337.53	3.15	2.150E+02	42.33	2.556E+03
7	618-	669	655.20	351.62	3.20	5.791E+02	49.57	2.374E+03
8	940-	963	951.07	510.41	2.48	6.661E+02	84.58	1.615E+03
9	1075-	1151	1086.76	583.22	3.15	5.340E+02	36.44	1.065E+03
10	1075-	1151	1135.25	609.25	3.21	5.429E+02	35.90	9.543E+02
11	1344-	1396	1354.33	726.82	4.37	1.426E+02	29.64	8.409E+02
12	1344-	1396	1384.77	743.16	4.41	6.135E+01	24.93	8.769E+02
13	1470-	1493	1481.31	794.97	1.99	5.892E+01	57.53	8.121E+02
14	1590-	1613	1601.98	859.72	1.48	1.122E+02	52.08	6.498E+02
15	1684-	1712	1698.41	911.47	2.91	4.489E+02	64.25	7.901E+02

16	1790- 1819	1805.01	968.69	1.00	2.216E+02	65.06	8.444E+02
17	2074- 2100	2087.24	1120.15	2.46	1.367E+02	53.26	6.153E+02
18	2293- 2320	2305.45	1237.25	0.78	9.020E+01	52.59	5.938E+02
19	2554- 2581	2567.48	1377.88	0.94	7.105E+01	32.69	2.209E+02
20	2705- 2738	2721.90	1460.75	3.37	1.924E+03	57.81	2.708E+02
21	2951- 2978	2964.29	1590.83	3.47	9.353E+01	32.72	2.165E+02
22	3205- 3297	3218.80	1727.42	4.70	7.206E+01	11.83	9.572E+01
23	3205- 3297	3283.06	1761.90	4.75	1.722E+02	16.90	1.334E+02

* Department of Soil, Water & Environment, The University of Dhaka, Dhaka

1.3 Energy Lines, Disintegration Process of Radioisotopes ^{131}I and ^{99m}Tc used in Nuclear Medicine for Diagnosis and Treatment Purposes

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

Objective: To study the half-lives, energy lines of ^{131}I &^{99m}Tc radioisotopes, and their activity decreasing process.

Current progress: The used injection syringes of ^{131}I &^{99m}Tc radioisotopes were collected from NINMAS in a lead shielded box and kept it in another lead shielding of Accelerator laboratory, AECD. Carefully, they were set in the gamma experiment chamber separately in separate times for experiments. The preset time was about 2000.41 seconds for ^{131}I experiment and 1000.84 seconds for ^{99m}Tc experiment. The spectrum data collection, process and analysis were controlled by Genie-2000 software through MCA. For ^{131}I experiments, five different energy spectrum lines were projected and they are; 80.83keV, 284.68 keV, 364.87 keV, 636.65 keV& 723.69 keV . The half-life of ^{131}I radioisotope is eight days and upto ten half-lives were taken under consideration for data acquisition. On the other hand, ^{99m}Tc has only one energy line that is 140.78keV and the half-life is 6 hours only. Analyzed spectrum and data results of ^{131}I &^{99m}Tc are given below;

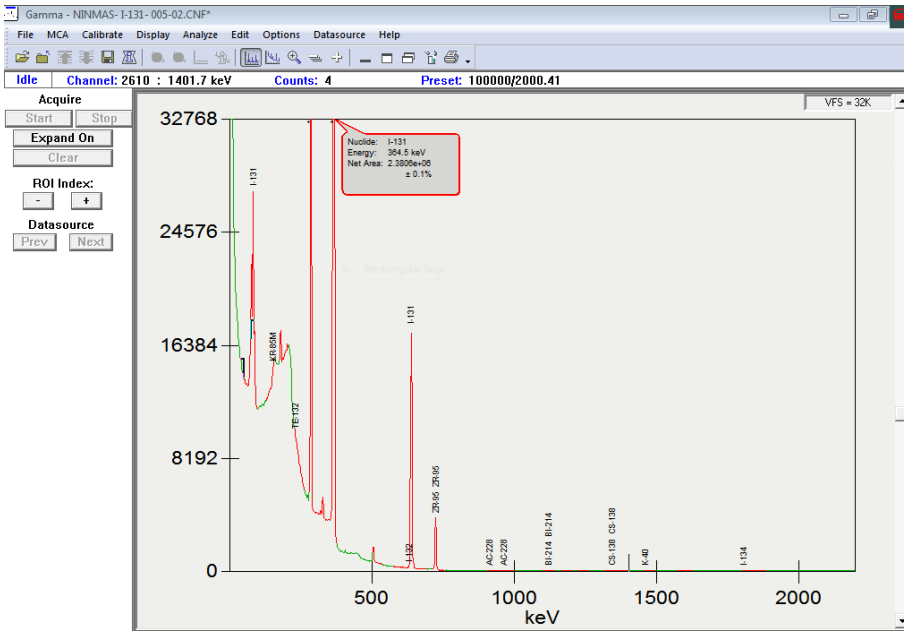

Fig: Analyzed Spectrum of ^{131}I(NINMAS)

P EAK ANALYSIS REPORT

Sample Identification: NINMAS I-131-005-02

Peak No.	ROI start	ROI end	Peak centroid	Energy (keV)	FWHM (keV)	Net Peak Area	Net Area Uncert.	Continuum Counts
1	117-	169	136.71	74.46	4.58	8.228E+04	552.93	3.450E+05
2	*117-*	*169*	*148.58*	*80.83*	*4.62*	*1.117E+05*	*594.85*	*3.331E+05*
3	263-	340	289.74	156.58	11.36	3.767E+04	830.28	8.156E+05

4	263-	340	326.83	176.49	11.46	2.088E+04	739.20	6.832E+05
5	364-	411	388.21	209.43	13.16	8.027E+04	2111.64	6.268E+05
6	*513-*	*553*	*528.44*	*284.68*	*3.06*	*2.343E+05*	*1180.02*	*1.871E+05*
7	595-	631	606.02	326.31	2.51	4.380E+03	904.61	1.446E+05
8	*653-*	*703*	*677.88*	*364.87*	*3.09*	*2.398E+06*	*1834.96*	*1.328E+05*
9	727-	768	753.29	405.34	2.93	6.583E+02	585.66	5.478E+04
10	824-	860	834.04	448.68	0.77	2.182E+03	464.03	3.788E+04
11	919-	1012	936.55	503.69	3.51	7.640E+03	129.75	1.262E+04
12	919-	1012	985.32	529.86	3.58	6.516E+02	76.77	9.217E+03
13	*1157-*	*1214*	*1186.18*	*637.65*	*3.27*	*1.215E+05*	*454.51*	*1.030E+04*
14	*1322-*	*1375*	*1346.51*	*723.69*	*3.36*	*2.819E+04*	*243.99*	*4.167E+03*
15	1848-	1875	1860.77	999.66	1.81	1.494E+02	35.50	2.456E+02
16	2009-	2034	2021.94	1086.15	0.54	6.808E+01	18.92	6.792E+01
17	2707-	2735	2720.55	1461.05	2.62	1.866E+02	17.80	2.840E+01
18	2952-	2979	2965.29	1592.39	1.30	2.616E+01	7.16	5.844E+00

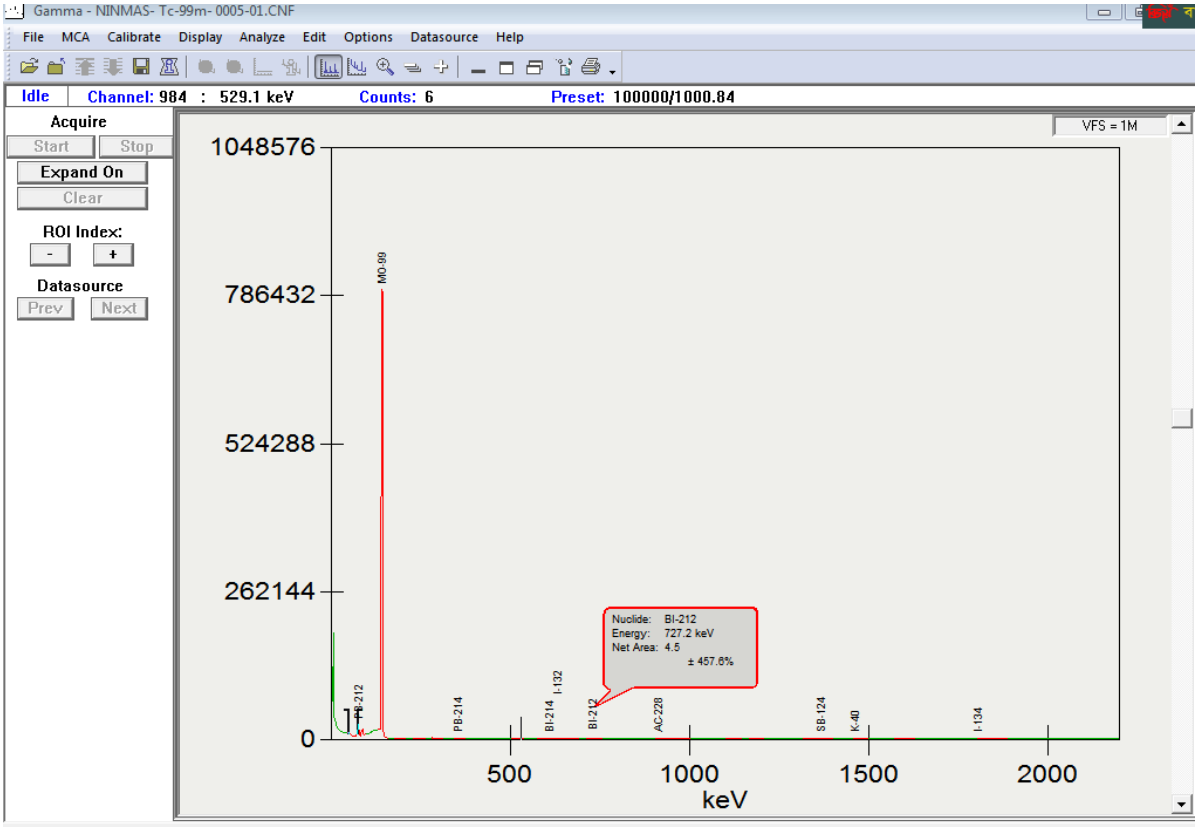

Fig: Analyzed Spectrum of ^{99m}Tc(NINMAS)

PEAK ANALYSIS REPORT: Sample ID: ^{99m}Tc0005-01

Peak No.	ROI start	ROI end	Peak centroid	Energy (keV)	FWHM (keV)	Net Peak Area	Net Area Uncert.	Continuum Counts
1	74-	105	85.41	46.93	7.61	3.878E+04	1091.80	2.289E+05
2	119-	332	137.77	75.03	1.83	1.080E+05	331.60	5.099E+04
3	119-	332	156.76	85.22	1.90	6.264E+04	297.79	5.401E+04
4	119-	332	178.96	97.13	1.96	3.430E+04	271.94	5.227E+04
5	119-	332	219.83	119.07	2.08	7.721E+04	320.29	4.809E+04
6	*119-*	*332*	*260.30*	*140.78*	*2.19*	*4.191E+06*	*4707.32*	*2.888E+04*

7	119-	332	306.65	165.65	2.31	2.459E+03	186.86	1.256E+04
8	382-	407	395.86	213.53	0.93	5.242E+02	267.96	1.676E+04
9	496-	540	519.11	279.67	3.81	1.458E+04	296.89	1.149E+04
10	644-	665	654.42	352.29	1.80	2.300E+01	36.00	3.370E+02
11	940-	961	950.55	511.20	1.17	4.028E+01	19.72	9.272E+01
12	1074-	1145	1085.80	583.78	2.37	3.792E+01	7.96	3.150E+01
13	1074-	1145	1134.28	609.80	2.43	4.520E+01	8.46	3.375E+01
14	2705-	2732	2718.96	1460.20	2.71	6.899E+01	14.04	2.801E+01

A PhD thesis will be submitted to the Department of Physics, Jahangirnagar University under this research programme.

* Department of Physics, Jahangirnagar University, Savar.

1.4 Assessment of Radiological Contamination of Baby Food 'Powder Milk' Collected From Local Market using 'Gamma Spectrometry' Technique

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

Objective: To assess the pollution level of 'powder milk' due to radiological contamination.

Current progress**:** Different types (brands) of powder milk were collected from local market and net weight of each of the packet was 500gm. Accordingly, the packet was being set in the experiment chamber, started the acquisition, collected gamma spectrums and analyzed the data files using commercial software Genie-2000. 'Aarong powder milk' was taken under experiment and the data acquisition period was 7450.30 seconds. ^{40}K, ^{140}La, ^{212}Pb, ^{212}Bi, ^{214}Bi, ^{208}TI, ^{228}Ac are projected against energy lines. The analyzed gamma spectrums (energy lines) and the data-results are shown below;

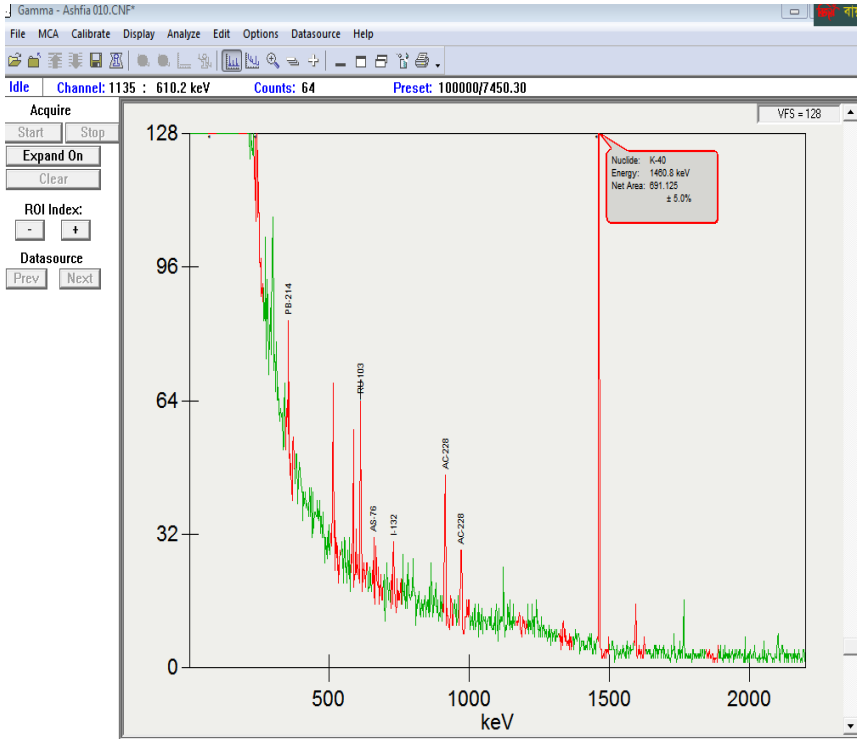

Fig: Analyzed Spectrums (energy lines) of 'Aarong powder milk'

PEAK ANALYSIS REPORT

Sample Title: Radionuclides Detection & Analysis

Sample ID : Aarong Powder Milk

Peak No.	ROI start	ROI end	Peak centroid	Energy (keV)	FWHM (keV)	Net Peak Area	Net Area Uncert.	Continuum Counts
1	12-	51	32.31	18.44	3.08	-5.917E+02	462.71	3.279E+04

2	125- 169	138.29	75.31	1.72	4.568E+02	43.20	2.015E+03
3	125- 169	156.72	85.20	1.79	2.652E+02	39.58	2.135E+03
4	264- 286	273.54	147.89	0.78	-1.398E+01	131.34	4.451E+03
5	422- 452	443.00	238.83	0.93	2.727E+02	124.88	3.141E+03
6	538- 558	548.12	295.24	1.11	1.344E+02	72.01	1.392E+03
7	643- 664	653.74	351.92	1.90	1.518E+02	62.74	1.007E+03
8	940- 964	951.17	511.53	2.68	2.877E+02	51.02	5.613E+02
9	1072- 1146	1085.49	583.61	1.91	1.685E+02	6.46	1.865E+02
10	1072- 1146	1134.53	609.93	1.98	1.811E+02	7.19	2.111E+02
11	1298- 1365	1309.29	703.71	2.36	3.741E+01	12.84	1.902E+02
12	1298- 1365	1353.93	727.67	2.41	5.646E+01	13.48	1.810E+02
13	1684- 1709	1696.84	911.69	1.78	1.562E+02	32.75	2.158E+02
14	1792- 1817	1804.63	969.53	1.90	1.198E+02	32.83	2.252E+02
15	2074- 2099	2086.10	1120.58	1.82	2.550E+01	31.27	2.235E+02
16	2708- 2735	2721.09	1461.34	2.17	6.837E+02	32.71	8.631E+01
17	2802- 2829	2815.15	1511.82	0.54	-2.403E+00	17.62	6.940E+01
18	2952- 2979	2965.01	1592.24	1.13	4.042E+01	18.31	6.558E+01
19	3272- 3301	3286.45	1764.74	1.51	7.302E+01	14.03	2.598E+01
20	3900- 3929	3914.40	2101.72	1.14	2.718E+01	14.47	3.782E+01

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

* Department Nuclear Science & Engineering, MIST, Dhaka.

Plasma Physics Division, AECD

Objective/Introduction

The plasma physics division is the newest division of the Atomic Energy Center, Dhaka (AECD). The division is started to work in January 2016 to promote fundamental, advanced and applied research works in the related areas of 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, Industrial plasma and Fusion plasma.

Activities

1. Research and Development Work(s)

1.1 Design and Development of an Efficient DPF Device

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

Current progress: A dense plasma focus (DPF) is a high pulsed co-axial accelerator that produces a high-density, high-temperature plasma along with pulsed x-rays, neutrons, electrons, ions, and electromagnetic waves. Fusion neutron and soft X-ray productions from DPF are studied.

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

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

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

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

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

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

Name of the Persons	Title of the event	Organizer	Date	Place
Dr. M. K. Islam	Instability of dust ion-acoustic waves in irradiated and streaming dusty plasmas with dust charge fluctuations	AECD	7 Apr. 2022	AECD
	Research activities and achievements of PPD: 2019 - 2022	AECD	11 Apr. 2022	AECD

3. Arranged Training/Seminar

Name of the person	Title of the event	Date	Place	No. of Participant
J. M. Haque and T. Tasnim	Industrial Training for the student Dept. of Nuclear Engineering, University of Dhaka	5-16 Dec. 2021	PPD, AECD	1

4. Collaboration Work(s)

The division is involved with the collaborative research work on the matters of common interest of the plasma physics group of different national and international universities. The division has close cooperation with teachers and research students (M.Sc., M.Phil. and Ph.D.) of various universities concerning academic works. Areas of collaboration during the reporting period are given below:

- Providing support to establish Fusion Laboratory in Khulna University under the collaboration work entitled, "Establishing Dense Plasma Focus Device in Khulna University."
- Working in syllabus committee as an expert: Physics Department, Rajshahi University and Physics Department, Pabna University of Science and Technology.
- Working as an examiner (To prepare question paper and checking of answer sheets), Dept. of Nuclear Engineering, University of Dhaka.

ATOMIC ENERGY RESEARCH ESTABLISHMENT (AERE), SAVAR

CENTRE FOR RESEARCH REACTOR (CRR), AERE

Objectives/Introduction

Center for Research Reactor (CRR) has been operating and supervising the Bangladesh's only nuclear research reactor "BAEC TRIGA Research Reactor (BTRR)". The BTRR is a valuable installation for various research activities in the field of Nuclear Science & Technology and it acts as a neutron source. It has a maximum steady state thermal power of 3 MW. The reactor achieved its first criticality on 14 Sept. 1986. The reactor has so far been used in various fields of research and utilization such as, manpower development

for nuclear power programme in the country, Neutron Activation Analysis (NAA), Neutron Radiography (NR), Neutron Scattering (NS), experimental reactor safety research, education, training etc. Center for Research reactor (CRR) is responsible for the operation and maintenance of the reactor and its associated equipment and systems with ensuring appropriate level of safety as delineated in the Safety Analysis Report (SAR). CRR is also responsible for the preparation of various Safeguards and Additional Protocol related reports for AERE facilities on routine basis as per the agreement with the IAEA. These reports are sent to Bangladesh Atomic Energy Regulatory Authority (BAERA) through Chairman of BAEC.Finally, BAERA sends the reports to the IAEA.

Activities

1. Research and Development Work(s)

During the reporting period the reactor was operated at different power levels depending on the requirements for reactor physics experiments conducted by CRR personnel and to provide neutron beam for various reactor users. During this period, the total operating hour was about 94.54hrand total burn up of the reactor fuel was about21.38MWh.A total number of 743samples were irradiated through 34 irradiation requests (IRs). Nuclear safety is the most important issues in the nuclear installations. The important reactor safety parameter such as burn up estimation, control rod worth, core excess reactivity, shutdown margin, loss of reactivity with power increases, reactivity coefficients, thermal hydraulic analysis and thermal power calibration of the reactor were measured during the reporting period by scientist/engineer of CRR. Study on these safety parameters of the nuclear reactor is very important for reactor safety and efficient operation.

Different groups of the Institute of Nuclear Science and Technology (INST) used the neutron beam of the reactor to carry out various Research and Development (R&D) activities. Neutron Activation Analysis technique is used to determine the trace elements present in soil, foodstuff, and vegetable samples. The Neutron Radiography group used the NR technique to detect voids, cracks, internal continuity in materials and determine water absorption behavior of jute plastic composites and various types of building materials e.g. bricks, tiles, etc. The scattering group used High Performance Powder Diffraction technique to characterize materials crystallographically and magnetically. The micro-structural information is obtainable by neuron scattering method which is very essential for determining its technological applications. This technique is unique for understanding the magnetic behavior in magnetic materials. Ceramic, steel, electric and electronic industries can be benefited from this facility to improve their products and fabrication process.

Reactor is operated for training, research, practical experiments related to safety, industrial attachment programme for students from different universities as well as for trainee from BAEC training institute.

2. Manpower Development and Training Programme

Title of the event	Date	Place	No. of participants
New Digital Radiation Monitoring System Installation	23 Aug. 2021	CRR	11
New Digital Radiation Monitoring System Software	23 Aug. 2021	CRR	11
Radiation Monitoring Detectors	23 Aug. 2021	CRR	11
Smart Dose Rate Meter: MDG-08e	23 Aug. 2021	CRR	11
Display System of Detectors	23 Aug. 2021	CRR	11
Local Display Unit LZJ-22	23 Aug. 2021	CRR	11
Hand foot monitoring system of BTRR	19 Sept. 2021	CRR	11
Installation and Operating Procedure of Continuous Air Monitor System	26 Oct. 2021	CRR	09
Lecture on Emergency Response Plan & Practical Demonstration on Emergency Evacuation	13 Dec. 2021	CRR	14
Lecture on Emergency Response Plan & Practical Demonstration on Emergency Fire Response	13 Dec. 2021	CRR	14
Brief description of past radiological and nuclear emergencies	13 Jan. 2022	CRR	19
Lesson learned from past radiological and nuclear emergencies	13Jan. 2022	CRR	19

Title of the event	Date	Place	No. of participants
Neutron flux measurement at neutron detector position	23Jan. 2022	CRR	17
Design and fabrication of necessary arrangement for the flux measurement at neutron detector position of BTRR	23Jan. 2022	CRR	15
Lecture on Different Charters of AERE	24 Feb. 2022	CRR	13
Lecture on Safeguards Activities in AERE	24 Feb. 2022	CRR	13
Lecture on Additional Protocol Activities in AERE	24 Feb. 2022	CRR	12
Protocol Additional to Safeguards Activities in AERE	15 Mar. 2022	CRR	11
Lecture on Emergency Response Plan & Practical Demonstration on Emergency Evacuation	22 Mar. 2022	CRR	13
Lecture on Emergency Response Plan & Practical Demonstration on Emergency Fire Response	22 Mar. 2022	CRR	12
The Basics of Physical Protection System of a Nuclear Facility	03 Apr. 2022	CRR	15
Status of the Physical Protection System of the BTRR	03 Apr. 2022	CRR	16
Status of the BTRR's Physical protection system in response to the IPPAS report	06 Apr. 2022	CRR	19
Practical Demonstration on Control Rod Reactivity Measurement of BTRR	18 May 2022	CRR	17
Practical Demonastration on Core Excess Reactivity Measurement of BTRR	19 May 2022	CRR	17
Safety Systems of the BAEC TRIGA Research Reactor	16 Jun. 2022	CRR	14
Security System of the BAEC TRIGA Research Reactor	16 Jun. 2022	CRR	14
Emergency Response Plan and Practical Demonstration on Emergency Evacuation	21 Jun. 2022	CRR	14
Lecture on Emergency Response Plan & Practical Demonstration on Emergency Fire Response	21 Jun. 2022	CRR	13

3. Collaboration Work(s)

- 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.

4. Repair, Maintenance and Renovation Works

Jul. 2021	• 10 H.P pump maintenance: Rubber Spacer, Lube oil were changed • Secondary Pipe Line Strainer Cleaning: Water remove of the secondary pipe line, Strainer cleaning and Priming of the Secondary pump • Maintenance work of 110 Volt (EM Room to control room) Distribution Board • Repair and maintenance of stack monitor • Installation of Security Lighting in the CRR facility Troubleshooting of variable frequency driver (VFD)
Aug. 2021	• Maintenance work of Heat Exchanger Air Tight Door Compressor Pneumatic Air Control Unit • 1250 kVA Sub-Station shut down and cleaning work completed • Installation of new Radiation Monitoring Equipment

Sept. 2021	• Quarterly Surveillance programme was performed • Maintenance & Replacement work of Main Entry Door Pneumatic System Control Box • New Set-up Installation work of 0.5 H. P Diesel loading unloading Pump for 650kVA generator Installation of new stack monitor and continuous air monitoring system
Oct. 2021	• Maintenance work of Secondary Pump-2 (Change the Rubber Spacer & Greasing the Pump) • Priming work of 650kVA diesel Generator • Calibration of RTD modules of Thermal Power Calculator Calibration of omega modules (DRF-RTD) of DAC
Nov. 2021	• Functional check and maintenance of the water-based fire protection system: Functional Check and churn test (operable condition) of the electric driven fire pump and associated systems were performed to ensure Fire Pump reliability • Electrical maintenance work of Main Entry door Control Box • Routine functionality check of all instruments of digital control console of BAEC TRIGA research reactor • Troubleshooting of variable frequency driver
Dec. 2021	• Annual maintenance and surveillance activities were performed for the following mechanical systems: Primary pumps, Secondary pumps, 250kVA & 650 kVA Generators, water treatment plant, fire pump, 10 HP pump, ventilation system etc. • Repair maintenance work of Fire Pump room & Outside Security room Intercom System • Repair and maintenance of digital control console of BAEC TRIGA research reactor • Routine health checkup and functionality check of Digital Console Software (TRIGA Application)
Jan. 2022	• Routine repair and maintenance of Reactor Protection System • Installation of new hand-foot radiation monitor • 1250 kVA Sub-Station cleaning and Maintenance • 10 H.P pump maintenance: Rubber Gasket (Spacer), Lube oil were changed
Feb. 2022	• Troubleshooting of variable frequency driver (VFD) • Solar system cable connection completed • Functional check and maintenance of the water-based fire protection system
Mar. 2022	• Maintenance of Pre-amplifier and whole channel of Log power module • New power Line Installation work of Water Filter System (2^{nd} Floor)
Apr. 2022	• Troubleshooting of DRF-POT module of the Regulating rod • Installation of new fire hydrant system • Installation work of Start & OFF switch in Distribution Board Box of 10 HP Pump • Cooling Tower Cleaning and Maintenance: Cleaning, Greasing of the cooling tower Fan (CT-1 & CT-2) along with priming of Secondary Pump & pipe line
May 2022	• Calibration of DRF-POT module of the Regulating rod • Installation of new fire detection and monitoring system • Installation work of Electrical Power Box in Continuous Air Monitoring System • Secondary Pipe line Strainer Cleaning: Water remove of the secondary pipe line, Strainer cleaning and Priming of the Secondary pump
Jun. 2022	• Replacement of the primary pump 2's VFD with a new VFD • Installation of new server, a monitor, and some new camera for the security surveillance • Maintenance, Installation & Replacement work of 1250kVA MCCB Circuit Breaker in Distribution Board (Ground Floor) • Installation work of 12.5 HP Submersible Pump-Motor and 60ft Pipe added in Boring • Semi-Annual maintenance and Surveillance programme were performed

INSTITUTE OF NUCLEAR SCIENCE AND TECHNOLOGY (INST), AERE

Radioisotope Production Division, INST

Objective

The objective of RIPD is to make the country self-sufficient in producing radioisotopes and radiopharmaceuticals. RIPD produces two medically important radioisotopes- Tc-99m and I-131 for diagnosis, imaging and treatment purposes which are extensively used in the 15 Nuclear medicine centers of BAEC and 6-7 other private & government run nuclear medicine departments of hospitals in the country. RIPD substituted the import of $^{99}Mo/^{99m}Tc$ Generator by indigenous production. An ISO certified clean room facility installed at RIPD is ready for production of Tc-99m cold kits (MDP, DPTA, DMSA etc.) and being received drug license and certification which is a prerequisite for radiopharmaceuticals production. Besides the generous support in the field of nuclear medicine in the country, research and development activities of RIPD based on therapeutic radioisotopes (Lu-177 and Y-90) and radiopharmaceuticals are also going on.

Activities

1. Radioisotope Production

- Routine production of $^{99}Mo/^{99m}Tc$ generator in weekly basis
- Routine dispensing of bulk I-131 solution in weekly basis.

2. Research and Development Work(s)

- Test Production of Different Cold Kits like DTPA, DMSA and MDP.
- Effect of Radioactive Concentration of $Na_2{}^{99}MoO_4$ on Chromatographic $^{99}Mo/^{99m}Tc$ Generator.
- Research on Different Tetraazamacrocyclic Ligands as ^{99m}Tc Cold Kit.
- Comparative Study of Different Radionuclides in the Imported Fission Produced ^{99}Mo Solution at Radioisotope Production Division
- In-House Production and Quality Control of ^{99m}Tc-MDP Radiopharmaceuticals at RIPD.

2.1 Evaluation of [18 F]FDG Synthesis and Quality Control: Experience in the Seoul National University Hospital (SNUH)

M. J. Uddin, M. M. Rahman, Y. H. Cho, C. S. Yoon, W. J. In, J. B. Park and Y. S. Lee

The purpose of this study was to evaluate the radiochemical yield at the end of synthesis and the quality of synthesized [18F]FDG according to the acceptance criteria mentioned in different Pharmacopeia (USP, EP) and Korea Food and Drug Administration (KFDA) to reduce the hazards of the patients and obtain the best quality of image for proper diagnosis. Method: Upon bombardment with a 16.5MeV cyclotron, Oxygen-18 enriched water is transformed into [18F]-fluoride ion. [18F]FDG was prepared by nucleophilic fluorination of Mannose triflate followed by basic hydrolysis. The entire synthesis was performed forty-six times using the chemistry module FASTlab2. The quality of produced [18F] FDG in the SNUH, South Korea was evaluated in a standard quality control laboratory. Radiochemical purity, radionuclide purity, chemical purity, pH, endotoxin tests were performed to ensure the quality of [18F] FDG before release. Sterility tests (FTM and TSB) and residual solvents (Acetonitrile and Ethanol) were analyzed after the release of the radiotracer. Result: The average decay corrected yield was (81.52 ± 8.33) % more than the average non-decay corrected yield (71.20 % ± 8.02 %). The TLC result of [18F] FDG showed more than 95% radiochemical purity. Gamma emission spectrum shown more than 99.5% of the gamma emissions correspond to 511KeV photons. The results of the other quality control parameters were in the desired range. The total produced [18F] FDG in forty-six batches had been used for the treatment of around 2100 patients and found no immediate or afterward hazards to any patients. Conclusion: The quality of synthesized [18F] FDG fulfilled all the requirements of USP, EP, KFDA and the radiochemical yield were in an acceptable range.

2.2 Study of Structural Characteristics of Ancient Bricks with Neutron Radiography Facility at BTRR

R. Barman, S. Saha, Md. S. Hossain, A. Das, Md. K. A. Rabby, A. A. Mahmud and D. Chowdhury

Neutron radiography (NR) has been applied successfully to investigate different types of building materials, rock samples, sculptures, statues or monuments for since long. The utilization of neutron imaging for non-

invasive investigations of cultural heritage objects is demonstrated on the example of ancient bricks found in Mahasthangarh and Sonargaon, two key archaeological sites in Bangladesh. The visualization of the internal structure of different brick samples, by means of Neutron Radiography (NR), has been experimented using the BTRR research reactor in Bangladesh - the only neutron imaging facility available in Bangladesh for R & D purposes. Manufacturing building materials havebecome a very good option for business in developing countries like Bangladesh. Among the non-destructive testing (NDT) techniques, neutron radiography is the most common procedure to identify light and organic materials, homogeneity, any inclusion or voids or cracks etc. inside the structure. The radiographic images in a dry condition for individual samples have been investigated. The image analysis was performed using ImageJ software and texture features were extracted using gray level co-occurrence matrix implemented by MATLAB for acquiring qualitative and quantitative information from this inspection technique at a high level of accuracy. The results obtained by neutron imaging provide the statement that the brick sample from Mahasthangarh is more homogeneous inside.

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

Name of the participant	Title of the event	Organizer	Date	Place
M. T. Islam	Long-Term Management Plan by Strengthening Capacity for Diagnostic and Therapeutic Radioisotopes and Radiopharmaceuticals Application	KOICA and KAERI	28 Jun. – 1 Jul. 2021	Virtual
R. Amin	Virtual Training Course on the Production and Quality Control of Theranostic Radiopharmaceuticals using Alpha and Beta Emitters	IAEA	14-16 Sept. 2021	Virtual
R. Amin and K. K. Hossain	Follow-up Training Course on Radiation Protection for Workers and RCOs of BAEC, Medical Facilities & Industries	TI, AERE	24-28 Oct. 2021	TI, AERE
M. T. Islam	FNCA Online Workshop on Research Reactor Utilization Project	MEXT	24 - 25 Nov. 2021	Virtual
R. Amin	Workshop on E-Governance & Innovation in Public Services	Innovation Team, BAEC	31 Jan. 2022	BAEC HQ
Dr. M. F. Waheed, Dr. R. Akhter, R. Amin and M. T. Islam	Training Course on the Product and Quality Control of Theranostic Radiopharmaceuticals using Copper-64 and Zirconium-89	IAEA	8 - 10 Feb. 2022	Virtual
	25th silver jubilee conference of Society of Nuclear Medicine (SNMB) 2022	SNB	20 May 2022	BICC, Dhaka
Dr. M. M. Rahman and Dr. M. A. Hossain	Training Course on e-Nothi Office Management	ICS, AERE	28-31 Mar. 2022	ICS, AERE
S. B. Amin, M. A. Shabuj	International Conference on Physics in Medicine (ICPM-2022)	BMPA and BAEC	26-27 May 2022	AEC, Dhaka

4. Manpower Development and Training Programme

Title of the event	Date	Place	No. of participants
Conducted full theoretical and practical courses of MD Residency (Nuclear Medicine) course of BSMMU	Mar. 2021 – May 2022	INST, AERE	10
Conducted 15 days training programme for the students of Department of Nuclear Engineering, Dhaka University	12-26 Dec. 2021	RIPD, INST	2
Industrial training programme 2022 for students of MIST, Mirpur, Dhaka	06-09 Mar., 2022	INST, AERE	25

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 in under implementation. Three scientific visits and one fellowship training have been completed.

6. Repair and Maintenance Works

- Operation & maintenance of the cGMP complaint computer controlled on-line ^{99m}Tc generator production facility at RIPD and ^{131}I 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 ^{99m}Tc Cold Kit Production Facility
- Repair & Maintenance of Centralized HVAC System.

7. Lecture Delivered

Scientists of this division conducted full theoretical and practical courses of MD Residency (Nuclear Medicine) course of BSMMU

8. Service Rendered and Revenue Income

Name of organization	Nature of service	No. of quantity	Revenue income
NINMAS and 14 INMASs; 6 Govt./Non-Govt. Hospitals including: CMH, Dhaka; LabAid, Dhaka; Evercare Hospital Dhaka; United Hospital Dhaka; NICVD, Dhaka & Ahsania Mission Hospital, Dhaka.	Supply of ^{99}Mo/^{99m}Tc generator	1034 no. of ^{99}Mo/^{99m}Tc generators	10,56,30,338/-
NINMAS, 14 INMASs and CMH, Dhaka	Supply of I-131 radioisotope	3684.76 GBq of Oral I-131 Solution	3,70,26,858/-
Total			14,26,57,196/-

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 Removal of Methylene Blue Dye from Aqueous Solution by Poly-Vinyl Alcohol/Acrylic Acid/Poly-4-Styrene Sulphonic Acid-Based Hydrogel

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

Poly-vinyl alcohol (PVA), acrylic acid (AAc), and poly-4-styrene sulphonic acid (PSSa) were copolymerized in different compositions using γ irradiation to form the hydrogel at a radiation dose range of 10-30 kGy. Adsorption capacity (qe) showed an increasing trend (44 mg/g) up to 0.05 g of hydrogel dose but after that, it showed a decline in capacity and almost reached 31 mg/g for 0.07 g of the hydrogel. Maximum removal efficiency was achieved (96.22%) for 0.05 g of dosage and minimum 30% for 0.02 g of hydrogel dose. At

neutral pH maximum removal efficiency (94.45%) and adsorption capacity (42.50 mg/g) were found.At 50ppm, 2000 ppm concentration the lowest and highest adsorption capacity were found 27.44 mg/g and 173.494 mg/g respectively.On the contrary, the removal efficiency showed an inverse trend, minimum removal efficiency (20.06%) at maximum dye concentration (2000 ppm) and vice versa. Within 50 minutes, 60% of the MB was adsorbed and reached the equilibrium within 285 minutes.

1.2 Investigation of Network Parameter of Starch, 4-styrene Sulfonic Acid(SSS), and 2-hydroxyethyl Acrylate (HEA) Based Hydrogel Prepared by Gamma Radiation

S. M. M. Hasnine, T. Ahmed, M. S. Rahaman, S. Sultana, M. J. Alam, M. M. Rahman, F. Khatun and K. Nipa

Hydrogel from starch, 4-styrene sulfonic acid (SSS), and 2-hydroxyethyl acrylate (HEA) was prepared by γ radiation at 1 kGy,3 kGy,5kGy from a ^{60}Co γ source. Concentrations of starch, HEA, and SSS were 5wt%, 5wt%, and 15wt%, respectively were used. HEA and SSS were mixed at a ratio of 1:3 with the starch solution.Network parameter like crosslinking density and porosity was investigated. The results showed that the crosslinking density decreased with increasing SSS concentration for SHS2 to SHS4 hydrogel. With increasing HEA concentration, the crosslinking density of SHS5 and SHS6 hydrogel increased. When the concentration of starch was increased, a similar increasing trend in crosslinking density was observed for SHS7 and SHS8 hydrogels. The porosity of the gel increased as the percentages of SSS increased for SHS1–SHS4 hydrogels, but decreased as the concentrations of HEA and Starch increased for SHS5–SHS6 and SHS7–SHS8 hydrogels.

1.3 Application of Gamma Radiation Assisted Polyethylene Oxide/Starch/4-Styrene Sulphonic Acid Based Hydrogel for Dyes and Heavy Metal (Cr^{3+}) Removal from Wastewater

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

Hydrogels with high porosity and interconnected netwroks of Polyethylene Oxide (PEO), Starch (S), and Para-styrene sulfonic sodium salt (PSSa) were prepared using gamma irradiation of 15 kGy. For adsorption of dyes and Cr^{3+} heavy metal onto PEO/Starch/PSSa based hydrogel pH effect, dosage effect, contact time and initial concentration-effect were investigated. The adsorption studies revealed that the adsorption kinetics followed pseudo second order. Adsorption isothermof methylene blue aligned most with Langmuir, while that of Cr^{3+} ion aligned with Freundlich.

1.4 Preparation and Characterization of Starch/2-Hydroxyethyl acrylate/4-Styrenesulfonic acid Sodium Salt Hydrogel by Gamma Radiation and Their Application in Methylene Blue Dye Removal

T. Ahmed, S. M. M. Hasnine, M. S. Rahaman, S. Sultana, M. J. Alam, M. M. Rahman, F. Khatun and N. Nipa

A series of Starch/2-Hydroxyethyl acrylate (HEA)/4-Styrenesulfonic acid sodium salt (SSS) based hydrogels were prepared by applying gamma radiation. When the starch concentration is 15%, the maximum gel content is 97.95%. It is found that the hydrogel composition has high water permeability and a high swelling ratio (3072%) at 25°C. Various kinetic and isothermal models were used to evaluate and optimize the dye adsorption capacity of the hydrogel with methylene blue as the model dye. The adsorption behavior of starch/HEA/SSS hydrogel is pseudo-second order, which is in good agreement with the Langmuir isotherm model, and the maximum dye adsorption capacity is 136.89 mg/g. Therefore, starch/HEA/SSS hydrogel can be used as a potential adsorbent to remove dye from wastewater.

1.5 Preparation and Characterization of Amine Functionalized Glycidyl Methacrylate Grafted Non-woven Polyethylene Fabric

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

Radiation induced grafting technique was applied to graft glycidyl methacrylate (GMA) on non-woven polyethylene (PE) films and amine functionalized GMA-g-non woven PE films were prepared through chemical treatment with triethylamine. Characterization of the adsorbent was performed by Fourier Transform Infrared Spectroscopy (FTIR) and Scanning Electron Microscopy (SEM) technology. The FTIR and SEM analysis provided proof of GMA grafting and amination. Amine functionalized GMA-g- non woven

PE films were treated with HCl to enhance its adsorption capacity and utilized for the adsorption of Cr (VI) ions from aqueous solution.

1.6 Preparation of Amidoximated Acrylonitrile-g-Waste Polypropylene Adsorbent by Radiation Grafting Method and Its Application on the Adsorption of Cr (VI) from Aqueous Medium

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

In this study, the pre-irradiation technique was employed for grafting of acrylonitrile (AN) on PP fabric. The grafting reaction was carried out at 80^{o} C in a water bath for 4 hours utilizing sulfuric acid (2% of AN) as an additive and the percentage of grafting obtained was 150% using 60% AN concentration and 30 kGy radiation dose. The amidoxime adsorbent was produced by treating acrylonitrile (AN) grafted PP (AN-g-PP) with $NH_2OH.HCl$ and characterized by FTIR, SEM, TGA, and DMA. The adsorption of Cr (VI) was investigated under various contact time, pH, temperature, and metal ion concentration circumstances. The equilibrium adsorption data were fitted to both Langmuir and Freundlich isotherm models. The maximum adsorption capacity of the adsorbent was found to be 232.56 mg/g calculated from the Langmuir equation. Kinetic studies have exhibited that the highest removal was achieved after 40 hours was 126.82 mg/g at pH 1.5 and Cr (VI) concentration 120 ppm. The kinetic data follow the pseudo-first-order model, and the estimated and experimental sorption capacities are in good agreement.

1.7 Radiation Induced Grafting for Preparation of Proton Exchange Membranes for Fuel Cell

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

Radiation induced grafting has been found to be one of the rapid and advanced technique which has been successfully used for Proton exchange membranes for fuel cell. In present study acrylic acid (AA) and sodium styrene sulfonate (SSS) were grafted onto polyethylene-tetrafluoro ethylene (ETFE) film using pre-irradiation method. After irradiation of the ETFE film with 50 kGy radiation dose the grafting reaction was carried out at 80ºC with monomer solution consisted of SSS: AA (1:2) and 4% NaCl in water. The properties of the membranes such as water uptake and oxidative stability were investigated as a function of ion exchange capacity (IEC). The new method showed to be promising in improving the properties of the membranes and reducing their cost of fabrication. The higher the grafting yield, the faster the response with respect to H_2O and H_2O_2. IEC varied 0.011 to 1.57 mmol/g with monomer ratio of 3:8 (SSS: AA) to 10:20 (SSS: AA).

1.8 Investigation ofKey Elemental Abundance of Potential Radiation Shielding Composites Fabricated by Indigenous Raw Materials

M. M. Rahman, F. T. Ahmed, S. Sultana, M. A. Ali and M. T. Miah

In order to protect living beings from ionizing radiation such as X-rays, γ-rays some indigenousshielding composites were fabricated using Madupur clay (MC) as base matrix which was reinforced with the filler of raw beach sand (RBS), inland sand (IS) and beach minerals such as magnetite, Ilmenite (M-I). The key elemental abundance of theindigenous prospective shielding ingredients have been determined by the neutron activation analysis (NAA) technique using 3MW TRIGA Mark-II research reactor at Savar, Dhaka. The NAA study reveals that the magnetite and Ilmenite have significantly large amount of Fe and Ti elements. This study also represents that the IS contains low abundance of heavy elements while the RBS contains significantly high level of heavy elements (Rb, Sb, La, Ce, Sm, Eu, Dy, Yb, Lu, Hf, Ta, Th, U) and low level of light elements (Na, Al, K etc.) with respect to the reference value (UCC). Moreover, the MC also exhibits slightly higher level of heavy elements with respect to the reference value. Therefore, the MC based MI and RBS composites exhibit high density than ordinary concrete which indicates the uplifting radiation attenuation behavior.

1.9 Analysis of Heavy Metals that can Impose Anti-diabetic Property to Human Health

F. T. Ahmed, P. Rajbongshi, S. A. Sweety, A. Akhter, L. Ghosh, A. Akter, S. Sultana, A. F. M. M. Islam, M. M. Rahman, M. A. Ali and M. T. Miah

Heavy metals are one of the components of food, though they are not synthesized in the body but they are essential for optimal health. Several metals are required for maintaining normal blood glucose level. This study was designed to investigate the profile of certain trace element having therapeutic properties related to diabetes mellitus. Our aim of this study was to assess the quantity of some heavy metals in vegetables collected from three different markets. 10 different vegetables samples of were collected from 3 different

areas (Savar, Dhamrai, pollibiddut) at affordable cost. Flame Atomic Absorption Spectrophotometer (FAAS) was used for metal quantification after successive acid digestion. This method has been used to measure the concentration of some important elements such as Zn, Cr, Cu, Co, Ni, Fe, Mn, Mg present collected vegetables. From result we see that Zn, Cr, Cu, Co, Ni, Fe, Mn, Mg were present 3.047 - 7.019; 2.985- 6.954, 0.896 - 7.706, 0.499 -10.594, 4.797- 17.063, 7.467 - 37.019, 2.417 - 28.366, 25.727 - 29.066 mg/kg respectively. Mg was found in highest amount in every vegetable of 3 different areas. The levels of selected elements in different studied samples suggests that except Cr and Mn (In 2/3 vegetables of 1/2 location) all other elements were within the permissible limits of FAO/WHO recommended values of vegetables indicating the vegetables were safe to consume.

1.10 Trace Elements Study of Some Commercially Available Energy Drinks in Bangladesh and Its Human Health Risk Evaluation

F. T. Ahmed, M. T. Islam, M. F. Alam, M. M. Rahman, M. A. Ali and M. T. Miah

Energy drinks are non-alcoholic beverages claimed to give extra burst of energy for daily obligation, promote wakefulness, and provide cognitive and mood enhancement. The primary objective of this research is to assess some trace elements in energy drinks and to evaluate the associated health risks of those metals with the consumption of energy drinks. In this study, twenty-two (22) energy drink samples were collected fromvarious super shops of Dhaka city and the physical parameters like pH, EC, TDS, Total acidity, total sugar content etc. has been measured. Flame Atomic Absorption Spectrophotometer was used to measure heavy metals like Fe, Mn, Cu, Zn, Ni, Pb, Cd, Cr and Co and UV-Visible Spectrophotometer was used for Al determination. For the assessment of non-carcinogenic risk, Hazard Quotient (HQ) and Hazard Index (HI) of each metal has been evaluated. In addition, carcinogenic risks of several elements were studied. pH of all the energy drinks were relatively very low which is not suitable especially for our dental health. Furthermore, Fe in all samples and Cr, Cd, Ni and Pb concentration in most of the energy drinks samples were much higher than WHO and BD standard value. The HQ of all heavy metals were below 1.0 for all samples (except a few for Cr, Co and Cd). The Hazard Index of Cr, Cd, Pb and Co were much higher than 1.00 (8.569, 13.250, 7.867 and 65.208 respectively). From the HI calculation the increasing non-carcinogenic threat for oral ingestion of energy drinks is OS<HL<RT<BR<BD<WB<HS<BH<RB<SH<RY<RE<ES<CB<PR< SP<EF<BV<TH<CR<PH<HK and for all samples the result exceeded the recommended limit ($HI \leq 1.00$). The carcinogenic risk factor was also calculated for Pb, Cr, Ni and Cd and it was found within the safety limit (1×10^{-6} to 1×10^{-4}) for all the samples. So, from present study it can be said that these drinks should be taken occasionally, not in a regular basis and if possible in a diluted way to save the teeth as well as the health.

2. Seminar/Conference/Workshop/Meeting Attended

Name of the participant	Title of the event	Organizer	Date	Place
Dr. S. Sultana	RAS 1024 Virtual Workshop on The Technical-Economic Feasibility Studies to Implement Radiation Technology for the Recycling of Polymer Waste	IAEA	24 Aug.-16 Nov. 2021	Virtual Meeting
	FNCA 2021 Workshop on Radiation Processing and Polymer Modification (RPPM) for agricultural, environmental and medical application	FNCA	29-30 Nov. 2021. .	Virtual Meeting
	TN-RAS7037-2104522 Virtual Regional Training Course on Sample preparation and analyses of stables isotopes in wetland samples.	IAEA	1-2 Dec. 2021.	Virtual Meeting
	International Conference on Physics-2022	Bangladesh Physical Society	19-21 May 2022	AEC, Dhaka
M. M. Rahman	International Conference on Physics-2022	Bangladesh Physical Society	19-21 May 2022	AEC, Dhaka

Name of the participant	Title of the event	Organizer	Date	Place
	25th Silver Jubilee National Conference of the Society of Nuclear Medicine Bangladesh (SNMB)-2022	Society of Nuclear Medicine Bangladesh	20 May 2022	BICC, Dhaka
	International Conference on Physics in Medicine-2022	Bangladesh Medical Physics Association	26-27 May 2022	AEC, Dhaka
Dr. N. Rahman	RAS 1024 Virtual Workshop on The Technical-Economic Feasibility Studies to Implement Radiation Technology for the Recycling of Polymer Waste	IAEA	24 Aug.-16 Nov. 2021	Virtual Meeting
	Second Research Coordination Meeting (RCM) on "Development of Radiation-Grafted Membranes for Cleaner and Sustainable Energy	IAEA	16-20 May 2022	Vienna, Austria
M. S. Rahaman	TN-EVT2102181 - RAS1024: Virtual Regional Training Course on Applied Radiation Technology as a Tool for Recycling of Polymer Waste, Vienna, Austria	IAEA	16 - 20 Aug. 2021	Virtual Meeting
F. T. Ahmed	Regional Training Course on "Design and Implementation of Wetland Isotope Programmes"	IAEA	28 – 29 Jul. 2021	Vienna, Austria (Virtual)
	"Administrative Innovations – Passport Seva Kendra and E-Office"	National Centre for Good Governance	06 Aug. 2021	Mussoorie,India (Virtual)
	International Conference on Physics - 2022	Bangladesh Physical Society	19 – 21 May 2022	AEC, Dhaka
S. M. M. Hasnine	International Conference on Physics - 2022	Bangladesh Physical Society	19 – 21 May 2022	AEC, Dhaka
	Development of biocompatible hydrogel for contact lens using quantum beam technique	INST, AERE	25 Oct. 2021	INST, AERE, Savar, Dhaka
M. N. Sardar	International Conference on Physics - 2022	Bangladesh Physical Society	19 – 21 May 2022	AEC, Dhaka
T. Ahmed	Virtual Regional Training Course on Applied Radiation Technology as a Tool for Recycling of Polymer Waste.	IAEA	16 - 20 Aug. 2021	Vienna, Austria (Virtual Meeting)
	International Conference on Physics - 2022	Bangladesh Physical Society	19 – 21 May 2022	AEC, Dhaka

3. Service Rendered and Revenew Income

Name of service	Quantity of sample	Revenue income
Ground water samples analysis to measure Na, K, Ca, Mg, Cu, Zn, Fe, Mn, Ni, Cd, Pb, Cr, Co, Cl^-, F^-, HCO_3^-, NO_3^-, SO_4^{2-} and PO_4^{3-}	12	---
Water Sample Analysis to measure Na, K, Ca, Mg, Cl^-, HCO_3^-, NO_3^- and SO_4^{2-}	03	---

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 following four areas:

- Radiation Protection Service (RPS): Providing routine and emergency radiation protection service throughout the country
- Environmental Radiation Monitoring (ERM): Conducting assessment and control of radiation exposure to occupational workers and the public
- Secondary Standard Dosimetry Laboratory (SSDL): Performing Standardization of radiation monitoring equipment's
- Radioactive Waste (RW) Management: Working on safe management of RW and radiation source (RS) including their ultimate disposal

Activities

1. Research and Development Work(s)

1.1 Radiological Risk Assessment of Farm-Raised Fish Species Due to Natural Radionuclides in the Freshwater Ecosystem of Bangladesh with the Statistical Approach

K. Asaduzzaman, F. J. Priya, D. Akter, E. Haque, M. Begum, K. Munshi and A. Hossen

We study radiation exposure resulting from the consumption of farm-raised freshwater fish species that form an essential part of the Bangladeshi diet. The levels of radioactivity in the human diet are of particular concern, requiring assessment of possible radiological risks to human health. Therefore, a comprehensive study was carried out to determine the radioactivity levels (226Ra, 228Ra, and 40K) in fifteen commonly available varieties of farm-raised fishes. The gammaray spectroscopic analysis showed the presence of radionuclides of 226Ra, 228Ra, and 40K in all studied fishes, but varying degrees. The highest radioactivity levels of 226Ra, 40K, and228Ra were observed in Rui (Labeo rohita) and Tilapia (Oreochromis mossambicus) with values of 8.50±0.30, 513.28±1.59, and 7.41±0.15 Bqkg−1, respectively. The respective radioactivity levels were lowest in Silver carp (Hypophthalmichthys molitrix), Mola (Amblypharyngodon mola), and Koi (Anabas testudineus) with values of 0.83±0.38, 171.07±1.60, and 0.62±0.30 Bqkg−1. The doses for 226Ra, 228Ra, and 40K due to consumption of a kilogram of farm fish were assessed and range from 5.56 (Sarputi – Puntius sarana) to 54.36 μSvy–1 (Rui – Labeo rohita), 9.77 (Koi – A. testudineus) to 116.79 μSvy–1 (Tilapia – O. mossambicus), and 24.23 (Mola – A. mola) to 72.69 μSvy–1 (Rui – Labeo rohita), respectively. In most cases, the estimated probability of an increase of cancer risk from daily intake of the farm-raised fish diet representing a minor fraction of ICRP values. Statistical analysis shows that the radioactivity and estimated radiological parameters are strongly correlated with 226Ra and 228Ra, while weakly correlated to 40K, suggesting that radiological risk is basically associated and controlled by the activity levels of uranium and thorium series radionuclides.

1.2 Determination of Dosimetric Accuracy of Newly Installed Cobalt-60 Teletherapy Machine at SSDL, Bangladesh

M. A. Aziz, T. Siddiqua, H. M. Jamil, N. Arobi, M. M. H. Bhuiyan, S. Paul, A. K. M. M.H.Meaze and M. S. Rahman

External beam radiotherapy or teletherapy is considered as one of the most effective modalities for cancer treatment. All emerging technologies in radiotherapy can only be fully utilized if there is high accuracy in dose determination and delivery. To maintain this accuracy, the IAEA protocolTRS-398 has recommended the calibration of ionization chambers at Secondary Standard Dosimetry Laboratory (SSDL) at regular intervals. In this study, the focus is on dosimetric accuracy of a newly installed Cobalt-60 teletherapy unit at SSDL of Bangladesh Atomic Energy Commission in purpose of rendering Quality Assurance and Quality Control services as well as research for all radiotherapy machines in Bangladesh. A series of measurements are taken that are essential for commissioning and acceptance of the newly installed Co-60 machine (Equinox 100)both in mechanical and dosimetric levels viz. accuracy of various indicators and field sizes, absolute and relative dosimetry, inter chamber comparison and comparison of absorbed doses measured with two protocols TRS-277 and TRS-398. IBA FC65-G Farmer chamber, IBA Dose 1 Electrometer and two different reference water phantoms are used for this study. The IAEA water phantom is used for dosimetry measurements in several fields and a 2D water phantom is used for the Percentage Depth Dose (PDD) calculation, beam profile measurements and other calculations.

The measured absorbed dose for several fields maintains a good accuracy as the output factors have a good consistency. The PDD curves for several fields have accuracy in the accepting range which indicates a good accuracy in the whole dosimetry. The beam profile for three different normal fields are found to be in a good level of accuracy since the linearity, penumbra and other parameters are in accepting level. The value of uncertainty in the dosimetric level is nearly 1.1 to 1.4% which is a good indication of accuracy. In case of inter chamber comparison the maximum deviation among values of absorbed dose to water for four Farmer chambers are 0.27% for $D_w(Z_{ref})$ and 0.26% for $D_w(Z_{max})$,which indicates a good sign of accuracy in the measurements.

This whole study is mainly focused on the calibration purposes to ensure the almost accurate dosimetry plan for treating a cancer patient. The resultant output of this study can also contribute in developing the treatment planning system in the realm of cancer treatment.

1.3 Evaluation of Natural Radionuclides Distribution in Beach Sands of Cox's Bazar Sea Beach, Bangladesh, using Multivariate Statistical Technique

K. Asaduzzaman, M. M. Islam and A. Hossen

The distribution of natural series radionuclides 226Ra, 232Th and non-series 40K in the heavy mineral-rich beach sands of highly touristic areas of Cox's Bazar sea beach has been studied. The study is made to evaluate the gamma radiation exposure to individuals with an aim to establish reference data for the presence of naturally occurring radionuclides. The present study reports the probable first attempt of detail and systematic work in the study areas for estimation of activity concentration in the recent beach sand samples. Radiometric analysis was performed using gamma ray spectroscopy system based on HPGe detector. The mean activity levels of 226Ra, 232Th and 40K in Laboni beach sands were ranged from 255.69±64.57, 336.83±93.96 and 1785.91±89.60 Bq kg-1, respectively. While in Kolatoli beach sands, the respective values were 166.42±35.99, 157.35±35.90 and 1894.42±74.07Bq kg-1, respectively. The mean values of 226Ra and 232Th concentrations in the investigated beach sands were estimated to be very much higher than the corresponding world average values and comparable to those found in high background radiation areas in the world. The heavy minerals seem to control the activity concentrations of 226Ra and 232Th in sand samples, showing some variances based on uranium and thorium bearing minerals. Various radiation health hazard indicators were found to be extremely higher when compared to the recommended values. Hence, heavy mineral-rich sands may pose a significant radiological health risk to the people. The descriptive statistics indicating the radionuclides of 226Ra, 232Th and 40K are uniformly and symmetrically distributed in the Cox's bazar beach sand. Multivariate statistical analysis showing the radioactivity and estimated radiological parameters are strongly positively correlated with 226Ra and 232Th, while weakly correlated with 40K, signifying that radiological risk is mainly associated and controlled by the radioactivity levels of uranium and thorium series radionuclides.

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

Name of the participant	Title of the event	Organizer	Date	Place
M. F. Uddin	International Conference on Physics in Medicine	BMPA	26-27 May 2022	AECD, Dhaka
S. Paul	International Training Course on the Security of Radioactive Material in Use and Storage	IAEA	11-14 Apr. 2022	VIC, Vienna, Austria.
	Advanced Instructor Training Course (AITC) on Nuclear and Radiological Emergency Preparedness	JAEA	26 Jul.-4 Aug. 2021	Ibaraki, Japan
	Workshop on Reviewing of survey activities and feasibility study report for proposed BAEC high power multipurpose research reactor project	BAEC	20-26 Jun. 2021	CRR seminar room, AERE & BAEC HQ, Dhaka.
K. Fatema	Seminar and workshop on Confirmation of Feasibility Study and Strategic Planning for Proposed BAEC High Power Research Reactor Project	BAEC	10-18 Feb. 2021	INST, AERE

3. Service Rendered and Revenue Income

Name of service	Quantity of sample	Revenue income
Radiation Survey	7	84,000/-
Calibration and Standardization	227	5,52,000/-
Radioactive source/waste interim storage	6	1,41,650/-
Environmental sample analysis	52	-
Total		7,77,650/-

Reactor Physics and Engineering Division, INST

Objective/Introduction

The programme 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 programme to meet the ever increasing demand of electricity.

Activities

1. Research and Development Work(s)

Neutronics and Thermal Hydraulics calculations are needed for efficient utilization and safe operation of nuclear reactor. In this regard MCNP modeling of TRIGA and VVER type reactor is going on. The division also supports Nuclear Engineering study programme of different local universities. 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 Programme

Title of the event	Date	Place	No. of participant
MEXT Advanced Instructor Training Course (Reactor Engineering) On line (Zoom)	12-21 Jul. 2021.	RPED, INST	01
EVT1905298 virtual TM on the Technical Challenges and Advances in Fuel Fabrication for Water Reactors: Recent Experience and Future Prospects	8-10 Nov. 2021	RPED, INST	01
E-Nothi Training Course	28-31 Mar. 2022	ICS, AERE	01
Skill Transformation for Industry 4.0: Application of Artificial intelligence & Design Thinking	17-21 Apr. 2022	RPED, INST (Virtual)	01

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

Name of the participant	Title of the event	Organizer	Date	Place
M. S. Mahmood, Dr. M. A. Motalab, M. A. Hossen and S. M. Shauddin	International Conference on Physics-2022	BPS	19-21 May 2022	AEC, Dhaka

Tandem Accelerator Facilities Division, INST

Objective/Introduction

One of the big facilities established in AERE is a 3 MV Tandem Accelerator, was procured by BAEC under an Annual Development Project of the Government of Bangladesh and installed on the AERE Campus, Savar, in 2010. The complete accelerator system has been manufactured by the High Voltage Engineering Europa BV, The Netherlands. The proton beam of energies up to 6 MeV is available at the accelerator. It had been successfully used for analytical work using the particle induced X-ray emission (PIXE) technique. Recently it was adapted to measure also nuclear reaction cross sections, especially of low threshold reactions, whose databases are rather weak. Furthermore, investigation of the (p,γ) process on light-mass isotopes of a few elements near the reaction threshold is of considerable significance in astrophysics. A highlight of this new activity was the measurement of cross sections for the production of the novel positron emitter at a low-energy cyclotron. The need and importance of such measurements in the production of novel positron emitters have been recently emphasized, especially in view of the solution targets being developed at small cyclotrons.

The main objective of this division is to keep the complex accelerator system operational and provide ion beam for doing research. The other objectives are the following:

- To train manpower in advanced nuclear technology
- To study basic nuclear phenomena
- To provide valuable data/information for various fields of applied sciences
- To study various environmental pollution in the country
- To help students to obtain academic degrees

Activities

1. Research and Development Work(s)

1.1 Elemental Analysis Using Particle Induced X –ray Emission Technique

M. M. Hasan, M. A. Shariff, M. S. Uddin and A. K. M. S. Ullah

The main objective of establishing the Tandem Accelerator Facility is to provide analytical service. Qualitative and quantitative analysis of various kinds of samples are focusing task using this facility. Various kind of agricultural, environmental, biological, material, geological and industrial samples, i.e. soil, water, air, food, blood, etc. can be elementally analyzed using Particle Induced X–ray Emission (PIXE) technique.

Major research work carried out in this division using PIXE technique can be listed as follows:

- Investigation of elemental and radiological contamination of soils in shipyards
- Study of soil samples and tree bark in ship breaking area to identify environmental pollution due to ship breaking activities
- Determination of lead contamination in human body by analyzing worker's 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
- Elemental analysis of cement found in local market
- Analysis the effects of textile dying effluents on soil and plant

1.2 Cross Sections of Deuteron-induced Nuclear Reactions on Al

M. S. Uddin

Deuteron-induced nuclear reactions in the low energy region are of considerable significance in nuclear research, both fundamental and application-oriented. Aluminium is an important structural element utilized in nuclear technology. The deuteron-induced activation cross sections on Al are of interest for proper estimation of radioactivity as well as for the safety in design and management of the International Fusion Materials Irradiation Facility (IFMIF). For understanding the mechanisms of deuteron-induced reactions on Al and validation of the prediction codes, detailed accurate production data for various radionuclides are needed.

Excitation functions of the reactions ^{27}Al(d,αp)^{24}Na, ^{27}Al(d,2p)^{27}Mg and ^{27}Al(d,p)^{28}Al were measured by the activation technique up to deuteron energies of 37 MeV. The available experimental databases of the reaction products ^{27}Mg and ^{28}Al were extended and compared with the nuclear model calculations based on the code TALYS-1.8. The cross-section ratio of the (d,αp) to (d,2p) process as a function of projectile energy was deduced from the measured data, and the result is interpreted in terms of competition between a proton and an α-particle emission. Based on the results of this work, it is postulated that after the stripping process, the probability of disintegration of the excited intermediate nucleus has a large preference for the emission of a complex particle compared to a single proton. This tendency appears to increase with the increasing projectile energy, resulting in the higher (d,αp) cross section.

1.3 Positron Emission Intensity in the Decay of ^{86g}Y

M. S. Uddin

Among the various imaging techniques used in diagnostic medicine, the positron emission tomography (PET) occupies a unique position. Since it is based on a coincidence measurement of the two photons generated in the annihilation of a positron in the tissue, it delivers more quantitative results than any other imaging modality. In this regard, the decay properties of the positron-emitting radionuclide affect the overall quality of the tomographic scan.

The β^+- emitting radionuclide ^{86g}Y ($t_{1/2}$ = 14.7 h) forms a matched-pair with the β^--emitting therapeutic radionuclide ^{90}Y ($t_{1/2}$ = 2.7 d) for theranostic application in medicine. This approach demands a precise knowledge of the positron emission probability of the PET nuclide which was till recently rather uncertain for ^{86g}Y. The positron emission intensity of ^{86g}Y was determined in this work experimentally through detailed γ-ray and X-ray spectroscopic analyses of radionuclidically pure sources. From those measurements, values of 27.2 ± 2.0 % for β^+-emission and 72.8 ± 2.0 % for *EC* were obtained. The new results should strengthen the database for improving the internal dose calculation while using ^{86g}Y for PET measurement in theranostic studies together with ^{90}Y.

1.4 Activation Cross Sections of Some Neutron-induced Reactions

M. S. Uddin

The fast neutron-induced reactions are of considerable importance in nuclear research, both fundamental and application-oriented. The fast neutron-induced activation cross sections are primarily of interest in Fusion Reactor Technology (FRT). Extensive studies have been performed over the last 50 years. In particular the (n,2n) and (n,p) reactions were investigated in detail. For other reactions, many more data are still needed. In

this work, attention was paid to the important elements Zn and Ge. A number of groups reported extensive data for the (n, 2n) and (n,α) reactions on the above target elements at around 14 MeV neutron energies. The data for two reactions, viz. ^{70}Zn(n,2n)^{69m}Zn and ^{74}Ge(n,α)^{71m}Zn, however, appeared to be somewhat discrepant, and additional measurements and intercomparisons were considered necessary. The aim of this work was therefore to measure cross sections of those two reactions with higher accuracy and to compare the results with nuclear model calculations.

The cross sections of the reactions ^{70}Zn(n,2n)^{69m}Zn and ^{74}Ge(n,α)^{71m}Zn were measured by the activation technique in combination with HPGe detector γ-ray spectroscopy. A nuclear model calculation based on the code TALYS-1.8 was also performed after adjustment of an input parameter for the spin distribution of level density. Through accurate measurements of excitation functions of the ^{70}Zn(n,2n)^{69m}Zn and ^{74}Ge(n,α)^{71m}Zn reactions the database has been strengthened and could be useful in further evaluation of the data. The results of the present experiment and the TALYS-1.8 calculation could be useful to remove the discrepancy in the existing data.

2. Repair, Maintenance and Renovation Works

- Regular maintenance of 40 KVA main UPS, 2KVA control room UPS and 15 KVA water cooling system UPS
- MPI CANNODE missing problem is solved by replacing optical T/R card by new one bought under IAEA TC project
- Fluctuation problem of ACC FC and BIV at LE side is solved by cleaning, re-soldering and washing with WD 40 of CPU card module located in LE CANNODE
- Voltage missing of einzellens 2 is solved by giving proper connection with the MPI CANNODE
- Outgassing of 358 Duoplasmatron ion source
- Operation of 358 Duoplasmatron ion source. Current found at ACC FC is 156 to 244 nA
- Identifying the regulation error problem related to magnet programme and magnet monitor on 358 source power supply unit is tried to be fixed
- Two tantalum capacitors, one resistor and two schottky diodes are replaced on connector PCB of 358 source power supply unit to solve burst and burning problems
- Finding the regulation error problem related to cesium reservoir on 860 source power supply unit is tried to be fixed
- Problems in driver section are identified as bursting a varistor and shorted of an IGBT on IGBT assembly in driver section. Damaged varistor and damaged IGBT are replaced to fix the problem. Adjustment procedures are followed to fix LOCK error problem. But varistor is burst and IGBT is shorted again. Various parts and section on output stage PCB board of driver are tested to identify any fault.
- SF6 gas leakage problem is solved by reconnection the top and bottom ground point of LC resonance circuit tank and top and bottom corona point of Accelerator tank by thread tape
- Q21 breaker fallen problem of DILO during gas recovery is tried to be fixed
- Repair and maintenance of 40 ton central AC and finding the problems in magnetic contactor, compressor and fans of the system
- Main control PCB of water cooling system was not functioning. One damaged industrial capacitor is replaced by new one. One 100 nF capacitor and one varistor are re-soldered. The board is finally repaired by Bangladesh Automation Company
- Leakage problem in air compressor is solved by replacing DD9 filter and auto drain kit

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

Name of the participant	Title of the event	Organizer	Date	Place
M. M. Hasan	IAEA Training Workshop on Accelerator Technology and Associated Instrumentation, Including Operation and Maintenance Aspects, IAEA Ref. No.: EVT1904154	International Atomic Energy Agency (IAEA)	22 – 26 Nov. 2021.	Virtual
M. S. Uddin	4 th International Conference on "Physics for Sustainable Development and Technology (ICPSDT-2022)"	Department of Physics, Chittagong University of Engineering and Technology (CUET	22-23 Jan. 2022	Online Platform
	International Conference on Physics in Medicine (ICPM-2022)	BAEC, BMPA and BMPT(DU)	26-27 May 2022	AEC, Dhaka
M. M. Hasan, M. A. Shariff, M. S. Uddin, A. K. M. S. Ullah, M. Hasan, F. Ahmed, M. L. Akhter and M. A. Hossain	"Operation, Troubleshooting, Repair and Maintenance Activities at 3 MV Tandem Accelerator Facilities of BAEC"	IAEA	22 – 26 Nov. 2021	Virtual

4. Collaboration Work/MoU

IAEA-TC Project Title: Strengthening Capacity in the Maintenance and Utilization of the Tandem Accelerator Facility, Code: BGD 0010, Period: 1-1-2018 to Continue.

The project has been initiated to improve the knowledge in the field of accelerator technology at the institute/ facility and to improve the Quality of life in the country.

With the expected following outputs/outcomes:

- Skilled manpower in the utilization of accelerator based nuclear analytical techniques and innovative research in bio-environmental sciences
- Safe and reliable operation and maintenance of the Tandem accelerator system
- New crop varieties developed

Unfortunately, out of fourteen scientific visits and fellowships, we managed to attend only seven due to COVID situation. So it was one of the reasons for not fulfilling the project outputs.

Still knowledge and experience gained by the fellowship, scientific visit and expert mission under the project is the main achievement so far. We received some important nuclear equipment procured through the project, which are otherwise difficult to obtain. We are still waiting more equipment to come.

Isotope Hydrology Division, INST

Objectives/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 environmental tracers (stable isotopes δ^2H & $\delta^{18}O$ & radioactive ^3H &^{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 Isotope Signatures and Hydrochemistry as Tools in Assessing Sources and Groundwater Aquifers in ChapainawbganjSadar and Nacholeupazila, Chapainawbganj

R. K. Majumder, M. Moniruzzaman, M. A. Q. Bhuiyan, M. A. Ahsan, A. H. A. N. Khan and F. Islam

Most of the part of Chapainawabganj district is laying in Barind areas, which is highly vulnerable in terms of declining groundwater trends due to the increased population, expansion of farming works and decreased surface water flow in Bangladesh. Several reports claimed that, the groundwater table is going down by 1 to 2 feet every year in some parts of this area. The main objective of this research is investigation of groundwater recharge mechanism and aquifer connectivity by isotopic and hydrochemical techniques. 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 Stable Isotope and Hydrogeochemical Evaluation of Groundwater in Tangail District, Bangladesh

R. K. Majumder, M. Moniruzzaman, M. A. Q. Bhuiyan, M. A. Ahsan, A. H. A. N. Khan and F. Islam

The groundwater system of Tangail district is little bit complex in terms of its geology. It is bounded by flood plains of the Jamuna River in its western part and uplifted Pleistocene terrace in eastern part. These two distinct subsurface geological conditions influence the groundwater quality. Total 80 groundwater and river water samples have been collected from Tangail district. However, the main objectives of this study has been set to analyze the evolution, origin & mixing of water using stable isotope technique to assess hydrogeochemical characteristics. The isotopic compositions (δ2H and δ18O) of groundwater of Tangail district range from -43.5 and -9.6‰; with an average of -26.43 ‰ and -6.84 and -2.07‰ with an average of e -4.57 ‰ respectively. The $\delta^{2}H$ and $\delta^{18}O$ values of floodplain portion of Tangail district fall close to the global meteoric and local meteoric water lines, that suggest that most of the groundwater sample are mixing through the aquifer, where rainwater is infiltrated though the sediment with slowly mixing into the groundwater. Oppositely, groundwater samples of Madhupur Tract are more enriched which indicates that comparatively old recharge. The enrichment of Mg^{2+}, Na^{+}, K^{+}, and HCO_3^{-} indicates the high water-rock interaction. Excessive use of fertilizer in agricultural field results in high concentration of SO_4^{2-} and NO_3^{-} in the shallow aquifer. The deep groundwater is comparatively fresh. Careful management of aquifers is highly recommended for sustainable development of groundwater resources.

2. Repair, Maintenance and Renovation Works

2.1 Maintenance of the Atomic Absorption Spectrophotometer

The Atomic Absorption Spectrophotometer (AAS) has been installed in 2009 and used to analyze several cations and heavy metals like Na, K, Ca, Mg, Fe, Mn, Cu, Zn, Pb, Cd, Cr, Ni etc. in different types of samples (i.e., rainfall water, surface water, groundwater, fog, soil, wastewater etc.). However, the analytical results of some elements were not satisfactory due to low lamp energy for most of the elements. A servicing has been then done by a service engineer to identify the drawbacks. Some recommendations have been given- (i)a 30 KVA online UPS system is required for controlling and stabilization of the temperature, (ii)new lamps are required to analyze the following elements:Sodium (Na), Potassium (K), Calcium (Ca), Magnesium (Mg), Manganese (Mn), Arsenic (As), Iron (Fe), Lead (Pb), Chromium (Cr), Nickel (Ni), Cadmium (Cd), Copper (Cu), Zinc (Zn), Aluminum (Al) and Barium (Ba), (iii) a new auto sampler belt of Graphite Furnace system is required to resume the auto sampler system, (iv) a new exhaust fan is needed to install.

2.2 Maintenance of the Liquid Water Isotope Analyzer (LWIA)

The Liquid Water Isotope Analyzer (LWIA) has been installed in 2014 for measuring $\delta^{2}H$ and $\delta^{18}O$ stable isotopes of water samples and functioning well till now. Recently the stable isotopes standard has been finished and we need to buy bulk volume of standards for future uninterrupted stable isotopes analysis. Also there are some shortages of instrument syringes.

2.3 Maintenance of the Water Purification System

The Water Purification System (Ultra-Pure) of IHD has been installed in 2008. But this system was not in working condition for last few years. A servicing has been then done to repair the system. Now, the system is functioning properly.

3. Manpower Development and Training Programme

Title of the event	Date	Place	No. of participant
Basic Training Course on Isotope Hydrology and Application of Isotope Techniques in Investigation of the Hydrological Cycle	23-27 Aug. 2021	Virtual Training	2
Advance in Data Processing and Interpretation Applied Isotope Hydrology Studies	27 Sept.- 3 Nov. 2021	Virtual Training	2
Installation, Setting-up Experiment, Calibration and Validation and Use of Cosmic Ray Neutron Sensor for Stationary Soil Moisture Assessment	1- 21 Mar. 2022	Zoom Meeting	5

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

Name of the participants	Title of the event	Organizer	Date	Place
F. Islam	Hydrogeochemical Evolution in Deep Aquifer Systems of Cumilla, Bangladesh	Bangladesh Physical Society (BPS)	06-07 Aug. 2021.	Virtual Training
	Groundwater Geochemistry and Hydrogeochemical Processes in the Aquifer Systems of Kushtia District, Bangladesh	Bangladesh Electronics and Information Society	27-28 Nov. 2021	AEC, Dhaka
	Assessment of Shallow Groundwater of Greater Mymensingh, Bangladesh: Using Hydrogeochemical and Isotopic Techniques (BPS-2022)	Bangladesh Physical Society (BPS)	19-21 May 2022	AEC, Dhaka
	Hydrogeochemical and Isotopic Assessment of the Groundwater in Kushtia, Bangladesh	National Seminar on Geoscience for Sustainable Development of Bangladesh	15 Dec. 2021	Virtual
Dr. M. Moniruzzaman	Hydrogeochemical Evaluation, Suitability and Potential Health Risk of Groundwater in Northern Tangail, Bangladesh: Isotopic and GIS Techniques	Bangladesh Physical Society (BPS)	19-21 May 2022	AEC, Dhaka

5. Collaboration Work

5.1 IAEA, RCA project RAS7035

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

Objectives

- To determine the origin, age and recharge mechanisms in different aquifers of the study area
- Identification of major hydrogeochemical process and natural and anthropogenic drivers of pollutants and/or seawater intrusion, extent and spatiotemporal variation of groundwater pollution
- Determination of vulnerability of the groundwater resource due to urbanization, demand driven factors, seawater intrusion and climate change

Expected Project Outcomes and Its Impact

- Knowledge on the hydrogeochemical processes in the study area as well as source and dynamics of the potential pollutants
- Knowledge on recharge mechanism of the aquifers
- Map of safe drinking water aquifers and groundwater hazard map for sake of the peoples

5.2 IAEA-TC Programme (BGD5033)

Title: Using Nuclear Techniques in Assessing River Bank Erosion, Period: Jun., 2019- Dec., 2022

Objectives

- Characterization of the geographical conditions of affected area
- Characterization of land use and agriculture in affected area
- Characterization of erosion phenomena
- Assessment of the problem
- Formulation of strategy for prevention and mitigation of flood and erosion
- Identification of the role of nuclear techniques to be used for this purpose in combination with conventional techniques

Expected Project Outcomes and Its Impact

It is expected that this study will be useful in characterization of the erosion phenomena and will be helpful in formulation of strategy for prevention and mitigation of flood and erosion.

5.3 IAEA, RCA Project RAS7040

Title: Improving Water Resources Management Practices by Enhancing the Regional

Collaboration in Environmental Isotope Analysis and Applications, Period**:** 2022-2026

Objectives

- To develop multi-isotopes using techniques ($^{87}Sr/^{86}Sr$, $\delta^{81}Br$,$\delta^{11}B$, ^{3}H and ^{14}C), data interpretation and modeling to assess the origin, source and seawater mixing
- Identification of the origin of groundwater salinity in the south-western coastal region of Bangladesh
- Mapping the regional geographic distribution of salinity prone coastal aquifers for the future sustainable groundwater management
- To inform the focal organizations and government of Bangladesh for the sustainable management and proper use of salinity free water for the future generation

Expected Project Outcomes and Its Impact

- Knowledge gaps about the origin of groundwater salinity in the south-western region of Bangladesh, i.e., whether the salinity comes from present seawater intrusion due to rising of sea-level or it is old water/connate water
- The coastal belt of Bangladesh is severely impacted by arsenic and salinity intrusion. Scarcity of supplying salinity free drinking water to the peoples
- Absence of use isotope techniques for identification of origin and residence time of sea water intrusion and salinity problem

5.4 IAEA-GNIP project

Title: Global Network for Isotopes in Precipitation, Period: 2009

6. Service Rendered and Revenew Income

Name of service provided	No. of sample	Revenue income
Under the Project entitled "Technical Study of High-Power Nuclear Research Reactor in Bangladesh," Isotope Hydrology Team carried out an isotope sampling programme to explore surface water and groundwater interactions throughout both the dry and rainy seasons. There were 32 samples of surface and groundwater collected in and around the proposed site of the High-Power Research Reactor for isotopic analysis.	32	1,12,000/-
Total		1,12,000/-

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 Assessment of Natural Radioactivity Levels and Radiological Hazards in Sediments of the Atrai River in Dinajpur

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

The distributions of naturally occurring radionuclides (^{226}Ra, ^{232}Th and ^{40}K) in river sediments collected from the Atrai river in Dinajpur district of Bangladesh have been measured using a gamma-ray spectrometry system to evaluate the radiological health hazards and excess lifetime cancer risk (ELCR). The mean activity concentrations for these radionuclides with standard deviations were 57.3 ± 24.6 Bq/kg of ^{226}Ra, 85.9 ± 56.5 Bq/kg of ^{232}Th and 1960 ± 198 Bq/kg of ^{40}K, respectively which are higher than the world average concentrations of these radionuclides in the river sediments that is 25, 25 and 370 Bq/kg, respectively. Due to natural radionuclides in sediments, the calculated average value of Radium equivalent activity was 331 Bq/kg, gamma representative level index was 2.55, external absorption gamma dose rate was 160 nGy/h, the annual effective dose was 0.20 mSv/y, external hazard index was 0.89, Internal hazard index was 1.05 and excess lifetime cancer risk was 0.69×10^{-3}. In this study, the average annual effective dose is 0.20 mSv/y which is within the accepted range of 0.46 mSv/y. But the average values of gamma representative index, external absorption dose rate, internal hazard index and excess lifetime cancer risk are relatively higher than the acceptance ranges. Therefore, the sediments of this river would carry a radiological threat to the population when they are used as a construction material.

1.2 Reconciling The Geogenic and Non-crustal Origins of Elements in an Indo-Bangla transboundary River, Atrai: Pollution Status, Sediment Quality and Preliminary Risk Assessment

R. Khan, A. H. Anik, K. Naher, M. A. Islam, U. Tamim, M. A. Azam, M. A. A. Talukder, I. Khalil, M. S. Islam and M. S. Uddin

This study has been conducted on an anthropogenically less influenced transboundary river (Atrai: Indo-Bangladesh) to comprehend the inherent geochemistry and identify potential elemental sources. In doing so, across the Bangladeshi portion, 30 river-bed samples were culled and studied by neutron activation analysis to quantify the abundances of 15 geochemically and toxicologically significant elementals (Na, Al, K, Ti, Cr, Mn, Co, Zn, As, Rb, Sb, Cs, Ba, Th, and U). The results revealed that the mean concentrations (µg/g) of Rb

(154.6), Cs (7.53), Th (20.90), and U (4.88) were 1.5-2.0 times higher than crustal values. Besides, geo-environmental indices revealed 'uncontaminated to moderately contaminated' pollution status with minor enrichment or contamination for Rb, Th, Sb, U, and Cs, relatively concentrated in the mid-to-downstream zone possessed geogenic and non-crustal origins. The positive matrix factorization and other statistical approaches revealed predominant geogenic enrichment of Na, K, Al, Ti, Zn, Cs, Rb, As, Th, and U from differential mineralogical compositions via weathering, elemental fractionations, and biogeochemical mobilization. Contrariwise, several anthropogenic sources (for Cr, Sb, Co, Mn, Th) were also ascertained in the vicinity of Atari River. However, sediment characterization based on SQG threshold values manifested that Cr and Mn possess rare biological effects on local aquatic organisms. Nevertheless, SQGs-based and ecological risk indices invoked minor to no potential ecotoxicological intimidations for the considered metal (oid)s (Cr, Mn, Co, Zn, As, and Sb). Hence, this study manifested the usefulness of a less anthropogenically affected river to reckon geogenic and non-crustal elemental origins in the compounded riverine sediment.

1.3 Environmental and Ecological Appraisal of a Transboundary River of Bangladesh (Punarbhaba) from Instrumental Neutron Activation Analysis (INAA)

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

An anthropogenically less affected transboundary river (Punarbhaba, Bangladesh) was studied to detect associated risks in order to comprehend the combined origin(s) of geochemically and toxicologically significant elements in benthic sediments.A total of 30 river bed sediments were analyzed by instrumental neutron activation analysis targeting the 15 chemical elements viz., Na, Al, K, Ti, Cr, Mn, Co, Zn, As, Rb, Sb, Cs, Ba, Th, and U. Among the estimated elements, the mean abundances (µg/g) of Rb (136), Sb (0.66), Cs (6.66), Th (14.6), and U (3.92) were 1.4-1.7 times higher than the crustal origin. These elements are primarily responsible for the contaminated state of the Punarbhaba River. The studied area is 'moderately polluted' and possesses 'minor enrichment' in terms of the measured elements. The output of statistical analyses projected that the studied elements are geochemically fractionated in an oxidizing environment (U/Th = 0.44) and mostly originated from felsic sources, thus, confirming the mineral is comprised of aluminosilicate and alkali feldspar. However, SQGs-based and ecological risk indices invoked minor to no potential ecotoxicological threats for Cr, Mn, Co, Zn, As, and Sb. Nonetheless, altered distribution patterns caused by geogenic activities increased Cr and Zn in the environment which may cause toxicity, and pose potential ecological risks, specifically in upstream locations. Further, this study broadened the perspective of sediment deposition from fractionation, fluvial transportation, and weathering events beyond the industrial disintegration of elements which will aid researchers and policymakers in intertwining the relationship of suspended sediments from both origins, and their associated risks.

1.4 Tracing The Tannery Contaminants in Dhaleshwari River with Systematic Sampling Approach

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

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 thirty-eight 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. 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.

Neutron Radiography

1.5 Variation of Resolution Parameter of Film Neutron Radiography with Reactor Power

R. A. Ramon, T Ahmed, R. Barman and S. Saha

Resolution of an imaging system like, neutron radiography (NR) is essential for dimensional measurements. Neutron radiographs are taken using different reactor powers. A dependence of image sharpness and image-system resolution with Reactor Power (RP) is evident in this work. Spatial resolutions were obtained for two reactor powers, 250 KW and 500 KW from experimentally measured Optical Density (OD) for same exposure time, 5min. The measurement of the spatial resolution of film neutron radiography technique was

based on the calculation of the full width at half maximum (FWHM) of the line spread function (LSF) acquired from a function called the edge spread function (ESF).

Neutron Scattering

1.6 Improvement in Structural Stability and Electronic Properties of Perovskite Oxide $SrZr_{0.5}Y_{0.5-x}Ca_xO_3$ by Doping Calcium for Solid Oxide Fuel Cell Application

J. Maudood, M. S. Islam, S. Hossain, M. S. Aktar, A. Hye and F. Ahmed

By virtue of enormous opportunity of doping, Perovskite oxides have allocated itself as an attractive contestant as electrolyte material for solid oxide fuel cell. A series of Calcium doped $SrZr_{0.5}Y_{0.5-x}Ca_xO_3$ (where x = 0, 0.1, 0.2, 0.3, 0.4) powders were synthesized by conventional solid-state method. All the samples were sintered at 1200 °C for 4 hours in air atmosphere. The doping influence on the structural properties has been explored by X-ray diffraction (XRD), Thermo-Gravimetric analyzer (TGA), Fourier transform infrared spectroscopy (FT-IR), Raman spectroscopy. XRD data showed that the material crystallized in orthorhombic symmetry with *Pmmm* space group. The effect of Ca doping on the microstructure has been analyzed by Scanning Electron Micros (SEM) which shows that the average grain sizes of the samples has significantly changed with doping of a small amount of Ca content. TGA revealed that the samples (x=0.2, 0.4) exhibited high thermal stability up to almost 800 °C, after that mass changed drastically. FTIR Analysis confirmed the presence of Zirconium- Oxygen (Zr-O), Calcium- Oxygen (Ca-O), Strontium- Oxygen- Strontium (Sr-O-Sr) bonds. Raman Spectroscopy confirmed the presence of Yttrium- Oxygen bond with all other bonds.

1.7 The influence of Magnesium Doping on $BaZr_{0.5}Y_{0.5-x}Mg_xO_3$ Perovskite Oxide for Applications in Solid Oxide Fuel Cell

J. Maudood, M. S. Islam, S. Hossain, M. S. Aktar, A. Hye and F. Ahmed

The influence of magnesium (Mg) doing on $BaZr_{0.5}Y_{0.5-x}Mg_xO_3$ perovskite oxide for increasing structural capacity and electronic properties were studied. The preparation and characterizations of $BaZr_{0.5}Y_{0.5-x}Mg_xO_3$ (where x = 0.0, 0.1, 0.2, 0.3, 0.4) materials were the main motif which will be used as possible electrolyte materials for intermediate temperature solid oxide fuel cell (SOFC). To get those materials, traditional solid state sintering method has been used. All the samples were sintered at 1200˚C for 8 hours in air atmosphere. The samples were characterized by X-ray diffraction, Scanning Electron Microscopy (SEM), thermogravimetric analysis (TGA), Fourier transform infrared spectroscopy (FTIR) and Raman spectroscopic technique. The x-ray diffraction patterns showed that the samples were in single phase orthorhombic crystal structure with the Pbnm space group. From the TGA measurements in nitrogen gas environment, it found that the confirmed that the functional groups appeared at 500, 850, 1410 and 1752 cm^{-1} in $BaZr_{0.5}Y_{0.5-x}Mg_xO_3$ were due to the Mg-O bending, Zr-O stretching, Ba-O stretching and O-O stretching modes. The SEM images of the samples showed that the average grain size of the samples has spectroscopy, elaborated inside view of the samples where the Y-O stretching mode was found perfectly. Experimental results of all the materials reveal that it can be suitable to use as electrolyte material in solid oxide fuel cells (SOFCs).

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

Name of the participant	Title of the event	Organizer	Date	Place
Dr. K. Naher	Advanced instructor training course (AITC) on Reactor Engineering	JAEA, Japan	12-21 Jul. 2021	Virtual training
	FY 2021 FNCA workshop on Research reactor utilization	MEXT and NSRA, Japan	23-24 Nov. 2021	Virtual workshop
Dr. M. A. Islam	National Conference on Physics-2021	Bangladesh Physical Society	6-7 Aug. 2021	Virtual Conference
	FNCA Project Meeting on Climate Change Research using Nuclear and Isotopic Techniques	ANSTO, Australia	11-12 Nov. 2021	Virtual workshop
	4th International Conference on "Physics for Sustainable Development and Technology (ICPSDT-2022)	PHY, CUET	22- 23 Jan. 2022	Online meeting

Name of the participant	Title of the event	Organizer	Date	Place
	Steering Committee Meeting between BAEC and Japan Atomic Energy Agency	JAEA	31 Jan. 2022	Virtual Meeting
R. A. Ramon	Follow-up Training Course on Environmental Radioactivity Monitoring	BAEC & JAEA	08-18 Nov. 2021	Zoom Online Platform
Dr. K. Naher, Dr. M. A. Islam and Dr. S. Hossain	International Conference on Physics 2022	Bangladesh Physical Society	19-21 May 2022	AEC, Dhaka

3. 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
- Atomic Energy Centre, Dhaka (AECD)

4. Others

NAA group of RNPD Actively Participate in the Following FNCA Projects:

- Research Reactor Utilization/NAA
- Climate Change Science Research using Nuclear and Isotopic Techniques

INSTITUTE OF ELECTRONICS (IE), AERE

General Electronics Division, IE

Objective

This division deals with the design, development, and fabrication of electronic and nuclear instruments which are mainly used for testing and measuring purposes. Several Nuclear Instruments have been designed in the General Electronics Division. These are Portable Radiation Dose Rate Meter (MDGE), Hand and Foot Radiation Monitor (HFRM), and Scintillation Survey Meter (SSM). These Instruments have been supplied to different Institutes and Industries across the country.

Activities

1. Research and Development

1.1 Microcontroller based Portable Radiation Dose Rate Meter

Microcontroller-based Radiation Dose Rate Meter (MDGE) has been designed and developed with analog display and working satisfactorily in several institutes. The improvement and digitalization work of this meter is going on collaboration with NED lab.

1.2 **Microcontroller Based Hand Foot and Cloth Contamination Monitor**

In order to improve the nuclear safety features of the existing Hand and Foot Radiation Monitor, the Microcontroller-Based Hand Foot and Cloth ContaminationMonitor has been designed and fabricated and working satisfactorily.Development work is going on.

1.3 Design and Development of a Microcontroller Based Area Radiation Monitoring System

Area Radiation Monitors are used in nuclear installations to ensure radiation safety of the personnel. Design and Development of microcontroller based digital ARM has been completed in cooperation with Nuclear Electronics Division. After fabrication one ARM has been supplied to BINA, Mymensingh. A new design has been developed and its Working Satisfactorily.

1.4 Design and Development of a Microcontroller Based Light Intensity Control System

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

1.5 Design and Development of Laboratory Power Supply

It is also a customized instrument for Radio Isotope and Production Division (RIPD). This division has a Laboratory-scale. To operate with this Laboratory-scale a Power Supply has been designed and developed by this division. The instrument is working satisfactorily.

1.6 Design and Development of Microcontroller Based Chiller Controller for VLSI Laboratory

Microcontroller Based Chiller Controller has been designed for VLSI Laboratory and working satisfactorily.

1.7 Software Development

1.8 Development of Microcontroller Based Instruments

2. Others

2.1 Production Work(s)

Area Radiation Monitoring Meter, Model: ARMIE-04, Serial No: 052201, Beneficiary: Department of Nuclear Engineering Department, CUET.

2.2 Repair and Maintenance Work

- Portable Radiation Dose Rate Meter, Model: DRGE-31, Serial No.: 120802, User: IRPT, AERE, Savar, Date: 21.09.2021
- Portable Radiation Dose Rate Meter, Model: DRGE-31, Serial No.: 060401, User: INM, AERE, Savar, Date: 12.10.2021
- Portable Radiation Dose Rate Meter, Model: Genstar, Serial No.: GH-102A, User: Five R Associates, Date: 25.10.2021
- Portable Radiation Dose Rate Meter, Model: MDGE-11, Serial No.: 101601, User: BSRM Steel Mills Ltd., Date: 25.01.2022
- Portable Radiation Dose Rate Meter, Model: MDGE-11, Serial No.: 070402, User: ICDDRB, Dhaka, Date: 16.02.2022

2.3 Electronic Re-Calibration of Radiation Instruments

- Portable Radiation Dose Rate Meter, Model: MDGE-11, Serial No.: 091101, User: BSRM Steel Ltd. Chattogram, Date: 17.08.2021.
- Portable Radiation Dose Rate Meter, Model: MDGE-11, Serial No.: 041101, User: Khawaja Yunus Ali Medical College & Hospital, Date: 17.08.2021
- Portable Radiation Dose Rate Meter, Model: MDGE-11, Serial No.: 040402, User: RNPD, INST, AERE, Savar, Date: 13.06.2022

4. Manpower Development/Training Programme(s)

Name of the participant	Title of the event	Organizer	Date	Place
All the scientists/ Engineers of this division	Industrial Attachment Training Programme for the students of different Polytechnic Institute of Bangladesh	IE	21 Dec. 2021 - 20 Mar. 2022	IE, AERE
	Industrial Training of fourth year student of Electrical and electronic Engineering department of Dhaka University of Engineering and Technology (DUET), Gazipur	IE	12 - 23 Dec. 2021	IE, AERE
	Industrial Training of fourth year student of Electrical and electronic Engineering department of Dhaka University of Engineering and Technology (DUET), Gazipur	IE	1 - 21 Nov. 2021	IE, AERE

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

Title of the event	Organizer	Date	Place
International Conference on Electronics and Informatics 2021	Bangladesh Electronics and Informatics	27 - 28 Nov. 2021	Dhaka
4th International Conference on Physics for Sustainable Development and Technology (ICPSDT-2022 On the virtual platform)	CUET	22-23 Jan. 2022	CUET
International Conference on Physics in Medicine (ICPM-2022	Bangladesh Medical Physics Association and BAEC	26-27 May 2022	AECD

Nuclear Electronics Division, IE

Programme(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 programme: Supervise/Guide thesis work
- Human resource development and training programme

Activities

1. Research and Development Work(s)

1.1 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 consol that will control and displays Irradiation time of the Co-60 source along with Compressor ON time. Development work is going on.

1.2 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.

1.3 Design and Development of a PIC based Digital Dose Rate Meter

Gamma events and dose rate calculation are very crucial in our everyday life to secure us from radiation and radioactive elements. In this design, a digitaldose rate meter is developed for assessing dose rate, which is highly cost-effective. To detect the gamma events a highly sensitive Geiger Muller (GM Tube) is used which is activated by a high voltage source. The measured dose rate is displayed on a liquid crystal display (LCD). Currently the system is being modified to make it more user friendly.

1.4 Design and Development of Ultrasonic Humidity Controller

It is a customized instrument for Insect Biotechnology Division of IFRB which is control the humidityof laboratory. One Ultrasonic Humidity Controllerhas been designed and supplied to IBD, IFRB.

1.5 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.

1.6 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.

1.7 Design and Development of High Voltage Power Supply System for Radiation Detection and Monitoring System

High voltage power supply (HVPS) is an elementary part in radiation detection and monitoring system and its importance has increased after entering into the era of Nuclear Power. A HVPS has been designed to power up NaI based scintillation detector and the system can be used to drive GM tube or Si based radiation detector after little adjustment that gives it scalability in the field of radiation detection.

1.8 LDR Based Light Sensor Development for Measuring Ambient Light Intensity

Indoor light intensity monitoring is very essential to maintain an optimum light level according to the specific requirements. Human comfort and wellbeing largely depend on the light level in an indoor environment which may vary from person to person and also according to their time of activities. In this project a light depended resistor (LDR) based light intensity sensor is developed which provides a low cost and dynamic solution to measure the intensity of light in lux(lx) unit. We are anticipating, this cost-effective lux sensor will be helpful to monitor light intensity more efficiently compared to other lx sensors available in market.

1.9 Design and Development of Artificial Environment and Monitoring System Using Microcontroller

Artificial environment is a very important part of research in the field of biology, micro-biology and medical science. It is being used to have a closer look on the instinctive habit and nature of specific animals, plants and insects. In this experiment Arduino Uno based intelligence system with other related sensors has been developed that monitors surrounding environment's temperature, humidity, light intensity and recreates these variables inside an enclosed area with the help of humidifier-dehumidifier, heater-cooler and lighting system. This artificial environment will make the animals and insects to express their instinctive habits and the observation on their habits will help us to achieve realistic results of laboratory experiments.

1.10 Design and Development of an IoT-Based Smart System to Monitor, Control and Record of Laboratory Environment

This work represents a microcontroller-based automated system employed to monitor and control the laboratory environment from the cloud. A standard LDR (Light Dependent Resistor) based light sensor was developed and a DHT (Digital Humidity and Temperature) sensor was used to acquire surrounding humidity, temperature and light intensity data. Those data were displayed on a Liquid Crystal Display (LCD) and can be accessed from the cloud.

1.11 Development of PIC-Based Frequency Counter

Frequency is the fundamental property of any signal that conveys important information in signal processing like radiation dose rate measurement. In these work a PIC16f876 based frequency counter is developed that counts the incoming signal frequency and displays it on an LCD. These system measures frequency up-to 56 kHz and consumes 25 mW of power.

1.12 Development of Cloud Monitoring System

Cloud monitoring system is very essential in modern life. A proto type of cloud monitoring system id developed based on ATmega328p microcontroller. The microcontroller is the main controlling unit of this system that employs an esp8266 module to connect with the nearest Wi-Fi and sends humidity and temperature data to Thing Speak platform. Data sent from the system can be monitored or processed from anywhere in the world accessing Thing Speak platform.

1.13 Development of Microcontroller Based Instruments

The Software Development of Microcontroller Based Instruments.

2. Participation in Training

- Scientist and Engineer of this division delivered lectures in the Industrial Attachment Training Programme from 21 Dec., 2021 to 20 Mar., 2022 held at Institute of Electronics, AERE, Savar, Dhaka for the students of different Polytechnic Institute of Bangladesh.
- Scientist and Engineer of this division Supervised Long Industrial Training from 12-23 Dec., 2021 of third year student of Nuclear Engineering department of University of Dhaka, held at Institute of Electronics, AERE, Savar.
- Scientist and Engineer of this division Supervised Long Industrial Training from01-21 Nov., 2021 of fourth year student of Electrical and electronic Engineering department of Dhaka University of Engineering and Technology (DUET), Gazipur, held at Institute of Electronics, AERE, Savar, Dhaka.

3. Sample Tested Using SEM

Date	Sample	Quantity	Name of Institute
20-21 Dec. 2021	Oxide powder	8	IE
4-6 Jan. 2022	Oxide powder(SEM+EDS)	8	IE
24 Jan. 2022	Unknown	6	INST,IRPT
26 Jan. 2022	Oxide powder	3	IE
30 Jan. 2022	Polymer	3	IRPT
6 Feb. 2022	Unknown	1	IRPT
7 Feb. 2022	Unknown	2 5 3	INST, RICD AECD RNPD, INST
13 Feb. 2022	SEM+EDS	6	IE
3 Mar. 2022	EDS & Imaging	4 3	INM, AERE IRPT
7 Apr. 2022	EDS Sample	1 7	IE
10 Apr. 2022	EDS	7	IE
11 Apr. 2022	SEM	2	IE
14 Apr. 2022	Raw sample(EDS+ SEM)	5	AECD
18 Apr. 2022	EDS SEM	3 2	IE
25 Apr. 2022	EDS	2	IE

Date	Sample	Quantity	Name of Institute
	SEM	7	
26 Apr. 2022	EDS	4	IE
9 Jun. 2022	EDS+ SEM	6	AECD
` Total		98	

4. Collaboration Work(s)

ADP Project

FahmidaAkter, CE of this division, working as a project Director of the ADP Project entitled "Improvement and modernization of the laboratory facilities of Institue of Electronics".

Production Division, IE

Objective

The Production Division is mainly engaged with fabrication, assembling and repair of the electronic instruments in order to meet the requirement of different institutes of BAEC and other organizations of the country.

Activities

1. Production Work(s)

Name of the equipment	Specification	Quantity
Production of Digital pH Meter	Upper cut-off voltage: 270V, Lower cut-off voltage: 120V, Time delay: Direct (No delay), 30 sec (For TV/Comp): 3 min (For Fridge), Stabilized output: 205-235V, Input voltage: 220VAC, 50Hz, Type: 160-250V, Weight: 8 Kg (Approx.).	1
Production of A.C. Voltage Stabilizer	Upper cut-off voltage: 270V, Lower cut-off voltage: 120V, Time delay: Direct (No delay), 30 sec (For TV/Comp): 3 min (For Fridge), Stabilized output: 205-235V, Input voltage: 220VAC, 50Hz, Type: 160-250V, Weight: 8 Kg (Approx.).	1
Production of Drop-Out Relay	Upper cut-off voltage: 250V, Lower cut-off voltage: 160V, Time delay: 3 min (Adjustable), Input voltage: 220VAC, 50Hz, Output (safe range): 160-250V, Weight: 1.8 Kg (Approx.).	6

2. Repair, Maintenance and Renovation Works

Name of the equipment	Quantity
Drop-out relay	5
A. C. voltage stabilizer	4

3. Lecture Delivered

- The scientists/Engineers of this division delivered lectures in the Industrial Attachment Training Programme from 21 Dec., 2021 to 20 Mar., 2022 held at Institute of Electronics for the students of different Polytechnic Institute of Bangladesh.
- Scientist of this Division arranged Industrial Attachment Training Programme from 21 Dec., 2021 to 20 Mar., 2022.

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 and Maintenance Work(s)

Name and description of the instruments	Intender
Desktop Computer, Model: E85-00970, Serial No: W000944578, Manufacturer: eversham, Country of Origin: China, Approximate Price of the Instrument: 40,000/-(Forty Thousand Taka Only)	Administration IRPT, AERE
Computer Monitor, Model: E170Se, Serial No: CN-OR49DY-64, , Manufacturer: DELL, Country of Origin: China, Approximate Price of the Instrument: 12,000/- (Twelve Thousand Taka Only)	Solar Cell, IE, AERE
Step Down Transformer, Model: 110V1500W, Serial No: N/A, Manufacturer: Polytech Electrical & Electronics, Country of Origin: Bangladesh, Approximate Price of the Instrument: 3,000/-(Three Thousand Taka Only)	AERD, IFRB, AERE
Water Distillation, Model: A8000, Serial No: 8501743, Manufacturer: Bibby SterlinLtd,UK, Country of Origin: England, Approximate Price of the Instrument: 3,00,000/-(Three Lac Taka Only)	AERD, IFRB, AERE
Laser Printer, Model: HP LaserjetP1102, Serial No: VNF7C22310, Manufacturer: HP, Country of Origin: Vietnam, Approximate Price of the Instrument: 20,000/-(Twenty Thousand Taka Only)	SIU, AERE
Motic MLC-150C, Model: MLC-150C, Serial No: 91006012, Manufacturer: Motic Canon, Country of Origin: China, Approximate Price of the Instrument: 50,000/-(Fifty Thousand Taka Only)	IE, AERE
Telephone Set, Model: L006A-2, Serial No: MNCNK6789JPQK76232XM, Manufacturer: Panasonic System Network Co.Ltd, Country of Origin: Malaysia , Approximate Price of the Instrument: 1,400/-(One Thousand Four hundred Taka Only)	IE, AERE
AC Circuit, Model: 0092WSE, Serial No: K08DR-0900WSE-C1, Manufacturer: General, Country of Origin: Japan, Approximate Price of the Instrument: 20,000/-(Twenty Thousand Taka Only)	ITBBR, AERE
Distill Water Plant, Model: WSE/45, Serial No: 9840, Manufacturer: Hamilton Lab. Ltd, Country of Origin: UK, Approximate Price of the Instrument: 2,00,000/-(Two Lac Taka Only)	IFRB, AERE
LCD Computer Monitor, Model: SyncMaster, Serial No: CM16H9FS624125, Manufacturer: Samsung, Country of Origin: China , Approximate Price of the Instrument: 12,000/-(Twelve Thousand Taka Only)	CAD, AERE
Ultrasonic Bath, Model: XUBA1, Serial No: U47535, Manufacturer: Grant Instrument, Country of Origin: UK, Approximate Price of the Instrument: 50,000/-(Fifty Thousand Taka Only)	IFRB, AERE
Laser Printer, Model: LBP3300, Serial No: LQHA573483, Manufacturer: Canon, Country of Origin: China , Approximate Price of the Instrument: 20,000/-(Twenty Thousand Taka Only)	INST, AERE

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

S. K. Sen attended the International Conference on Physics 2022, organized by BPS, Dhaka dated 19-21 May, 2022, at Atomic Energy Centre, Dhaka, Bangladesh.

3. Lecture Delivered

Scientists and Engineers of the division delivered lectures for the students of different Polytechnic Institutes under Industrial Attachment Training Programme.

Robotics Instrumentation and Control Division, IE

Objective

- Robotics
- Instrumentation using Metamaterials
- Design and Development of Control Systems

Activities

1. Research and Development Activities

1.1 Subwavelength Ultrasonic Imaging via a Harmonic Resonant Tunneling Metalens

S. Hur, H. Jeon, M. A. U. Zaman, Y. Kim, M. A. Shah, J. Kim and B. C. Lee

Resonant tunneling metalenses have excellent applications for subwavelength ultrasonic imaging in air. In this study, an acoustic metalens intended for underwater imaging was designed with first, second, and third resonant tunneling frequencies of 10.3, 85.3, and 105.9 kHz, respectively. The resonant tunneling metalens and letter-shaped validation specimens were fabricated via additive manufacturing using polymers. Before the underwater experiment, an array of 36 channels of lead zirconatetitanate elements was installed at the bottom of a test water tank to generate ultrasonic waves. Next, the resonant tunneling metalens and one of the letter-shaped specimens were placed in the tank, and ultrasonic imaging was performed with a needle-type hydrophone. Experimental results at the third resonant tunneling frequency confirmed that subwavelength ultrasonic imaging of the letter-shaped specimen was possible at a minimum level of $\lambda/13.98$. Therefore, the proposed metalens is shown to be suitable for high-resolution ultrasound applications such as biomedical and non-destructive imaging.

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. The instrument has been supplied toICS, IFRB, AERE, Savar, INMAS, Dhaka and it is working satisfactorily.

2. Repair, Maintenance and Renovation Works

Repair and maintenance of Rapid Thermal Annealer/Processor (RTP) at VLSI lab,IE.

3. Production of Electronic Gazettes

Total number of productions of AC change over switch is (7 Pieces).

4. Manpower Development/Training Programme(s)

Name of the participant	Title of the event	Organizer	Date	Place
M. Anzan-Uz-Zaman	Introduction to an FEM based purchased commercial Multiphysics Software	IE	24 Mar. 2022	IE, AERE

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

Name of the participant	Title of the event	Organizer	Date	Place
M. A. U. Zaman	e-Nothi Office Management	ICS	28-31 Mar. 2022	ICS, AERE
	All Day long e-Governance and Innovation in Civic Service	Innovation Team, BAEC	26 May 2022	BAEC HQ
	Informing about what to do to meet the challenges of the 4th Industrial revolution	Innovation Team, BAEC	14 Jun. 2022	BAEC HQ

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

Activities

1. Research and Development Activities

1.1 Design, Development and Simulation of a Microcontroller Based Frequency Counter

M. N. Islam, M. S. Alam and M. A. S. Haque

In this research, design, development and simulation of an ATMEL microcontroller (μC) based frequency counter has been presented. The System consists of signal processing electronics integral discriminator, High-performance, Low-power Atmel AVR CMOS 8-bit Microcontroller ATmega8L as the Processor, LCD display (16 ch, 2-line) and low voltage power supply. An assembly language programme based on BASCOM AVR IDE has been developed to control the operation of the designed system. The system has been designed, tested and verified in Proteus 7.7 simulation platform. The data has been provided in the table1 for verifying the system performance. The system has been periodically tested with several counting (pulse/sec) levels. The pulse generator properties were positive polarity, direct 0 to 5V output ranges from 100 Hz to 5 KHz in the simulation platform.

1.2 Recent Development in Microwave Imaging and Its Applications

N. Islam, M. S. Alam and M. A. S. Haque

Recent Development in microwave imaging and its applications have been presented in this research. The study includes electromagnetic modeling, system architecture and system components for instance transmitter, dielectric object (2D-3D), array of receivers and wide-ranges of applications from through the wall imaging to medical diagnostics, nondestructive testing & evaluation, concealed weapon detection at security check points as well as structural health monitoring by applying electromagnetic (EM) waves in the microwave imaging domain 300 MHz-300 GHz. Microwave image processing and image reconstruction algorithms also have been presented in this research.

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

Title of the event	Organizer	Date	Place
A seminar on "National Policy of Bangladesh for the Management of Radioactive Waste and Spent Nuclear Fuel: Development to Approval and Salient Features	Institute of Nuclear Science and Technology	3 Nov. 2021	AERE
Virtual Conference: "4th Asian Conference on Science, Technology and Medicine (ACSTM)-2021	Asian Council of Science Editors	20 - 21 Nov. 2021	Dubai, UAE
International Conference on Electronics and Informatics 2021	Bangladesh Electronics and Informatics	27 - 28 Nov. 2021	Dhaka
"Nuclear Power Programme of Bangladesh: Involvement of HPRWMU as a Technical Support Organization"	Institute of Nuclear Science and Technology	12 Jan. 2022	AERE
An Online Training Course on "Charging Batteries from Solar"	Microchip University	3 Apr. 2022	AERE
Lecture delivered in the Industrial Attachment Training Programme-2021 for the students (30) of Kishoreganj, Moulvibazar and Jessore Polytechnic Institutes	Institute of Electronics	21 Dec. 2021 – 20 Mar. 2022	AERE
Observed the Testing/Training on LPKF Protomat, S64, LPKF CircuitPro PM 2.7 Document, LPKF Leaser & Electronics	Institute of Electronics	25 Jan. 2022	AERE
A machine training seminar on "Rapid Thermal Processing System with Square Chamber", AS Premium by annealsys	Institute of Electronics	7 Apr. 2022	AERE

Title of the event	Organizer	Date	Place
Virtual Event: Nuclear Energy the Future Zero Carbon Power	American Society of Mechanical Engineering	4-6 Aug. 2021	USA
Physics for 4th Industrial Revolution and Beyond	Bangladesh Physical Society	19 -21 May 2022	AEC, Dhaka
Physics for Sustainable Development and Technology	Department of Physics, CUET	22 -23 Jan. 2022	Chattogram

Very Large Scale Integration Technology Division, IE

Objective

Very Large Scale Integration (VLSI) Technology Division has started its journey since 2012 in Bangladesh Atomic Energy Commission, Savar, Dhaka. This division has two clean-rooms (white room of 10,000 grade and yellow room of 1,000 grade) with several microelectronic device fabrication and characterization instruments. This Laboratory opens a new horizon in microelectronics and semiconductor research field for the first time in Bangladesh.

Activities

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

INSTITUTE OF COMPUTER SCIENCE (ICS), AERE

Nuclear Cyber Security Division, ICS

Objective/Introduction

The major aims and objectives of Nuclear Cyber Security Division (NCSD) are to conduct basic & applied research on nuclear cyber security, computer network and information security, cyber physical infrastructure with new 4th industrial technologies, etc. NCSD also provides training in the field of relevant security issues, cyber security building awareness and ICT for the development of human resources at BAEC. NCSD publishes several articles in the peer reviewed journal, conference proceedings, and participates in the relevant international/national seminars and workshops. This division provides the ICT services to BAEC as well, such as BAEC domain based official email services, Management Information System, E-Nothi services, software and web application development, maintenance, and upgradation of inter-network infrastructure of BAEC through ensuring security at core level network system, manpower development etc. Now a days it also meets up the information and cyber security of the Atomic Energy Research Establishment through the successful implementation of the Firewall services. Establishing a data center is going on under the supervision of NCSD Lab for the data security and digitalization of different activities for the Commission. NCSD has developed Moodle based e-learning management software as a part of human recourses development and nuclear cyber security awareness to the public. NCSD is also serving for the implementation of secure e- nothi system at BAEC as an administrator of E-Nothi system.

Activities

1. Research and Development Work(s)

1.1 Research on Nuclear Cyber Security and Network Security at BAEC Perspective

M. S. Islam, K. N. S. Mitu and M. D. Hossain

ICS presents the Network System such LAN and Wi-Fi at BAEC HQ, AERE and AECD through the efficient design, development and implementation. A large number of computers and digital control systems are connected with these networks publicly or privately. So, it's a challenging issue to ensure network

security for these networks and nuclear cyber security which is concerned with the nuclear related digital control system. Nuclear Cyber Security lab is continuing its research activities and expanding services activities to prevent, detect and respond malicious or unauthorized acts directed at nuclear & radioactive material and its digital control system and providing high assurance security that digital computer, communications system and networks are adequately protected against cyber attacks.

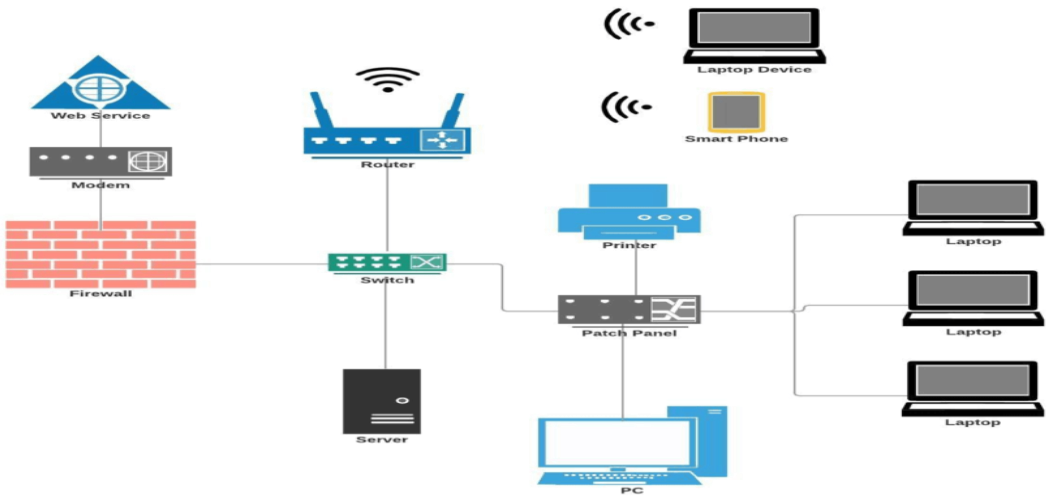

Fig. A Simplified AERE Inter Network Architecture

At present, CISCO next-generation hardware firewall has been implemented at ICS network server room, AERE as part of ensuring the core network security. This firewall is running under the supervision of NCSD division.

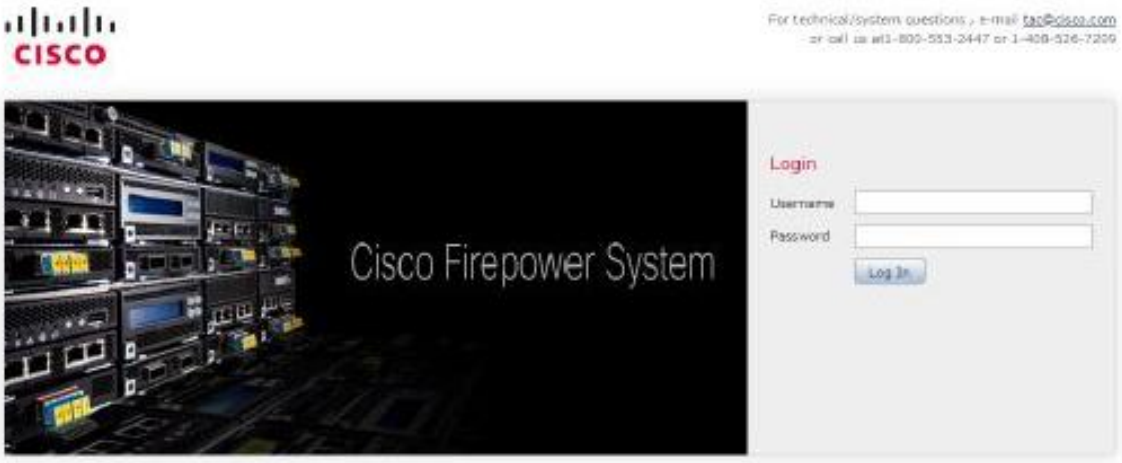

Fig CISCO Firepower System at ICS Server Room

1.2 Continuation of Moodle Based E-learning Management System for Implementing Online Nuclear and Related Education at BAEC

M. S. Islam, K. N. S. Mitu, M. A. Uddin and M. D. Hossain

Bangladesh Atomic Energy commission (BAEC) is a research organization where different academic curriculum with research is going on. For this purpose, different institutes of BAEC offers specialized training courses, Industrial attachment training, different nuclear activity short term or long term courses etc. So to make easier this kind of training course, Moodle based E-learning Management System has been developed at NCSD division of ICS Network Local server**.** Moodle is used to administration, documentation, tracking,

reporting and delivery of educational courses or training programmes.

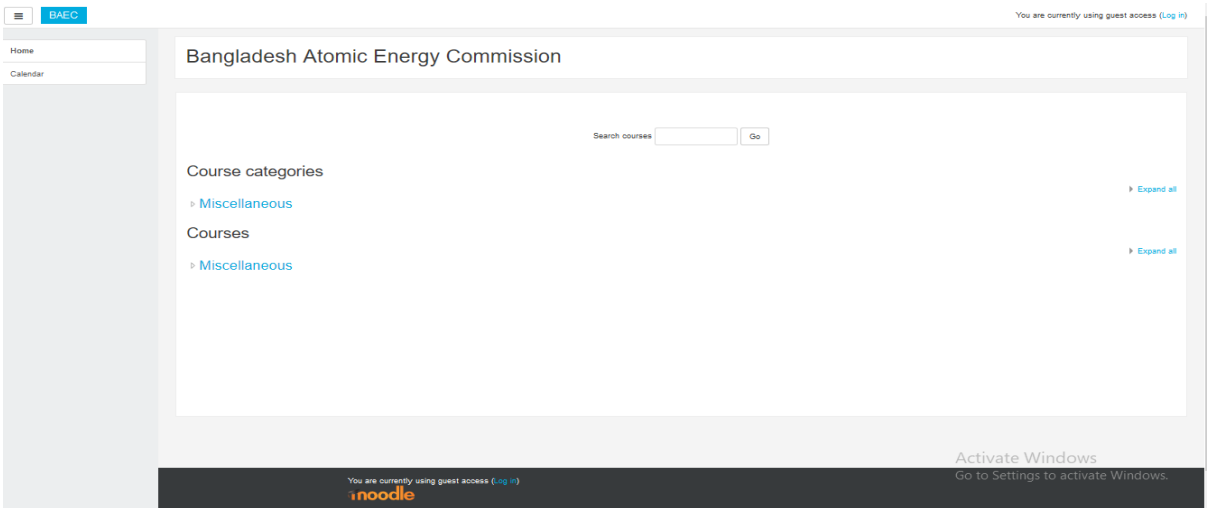

Fig. Moodle Based E-Learning Management System at BAEC

1.3 Research on Nuclear Knowledge Management System

M. S. Islam, K. N. S. Mitu and M. D. Hossain

Bangladesh Atomic Energy commission (BAEC) is a largest research organization in Bangladesh where multidisciplinary researches are taking place. Nuclear Knowledge Management (KNM) is one of the paramount research areas of NCSD lab according to the BAEC current demand. Nuclear Knowledge Management is conducting the research for acquiring, transforming, developing, disseminating, cloud-based and centralized preserving and sharing knowledge, relevant to achieving specified nuclear knowledge. Automation and nuclear data simulation are also needed as a part of nuclear knowledge development for the BAEC. Documentation and Research in this area are in progress.

1.4 A Private Cloud Configuration to Meet-up the 'Big Data' Challenges of BAEC and its Establishments

K. N. S. Mitu and M. D. Hossain

Current and upcoming era is the era of Big Data, where it comes along with challenges between Big Data storage, processing and security that raise problems. On one side, the large amount of trust related data must be highly available, flexible, and fast processing and on the other side, the trust and security of Big Data are the challenges.

No doubt, various types of BAEC data such Biological Data, Medical Record Data, Physical Data, etc. can strengthen the 'Big Data' concept in the context of data collection point of view. According to the present-day information security crisis there is an extreme need for the storage and management of the trust-worthy data through the private cloud adoption.

This proposal highlights the challenges of Big Data management in the context of BAEC establishment and presents a private cloud storage solution to meet up these challenges for the BAEC and its establishments through the efficient design, development, and implementation. This study also discusses the capabilities of the private cloud storage as it is more superior to public cloud for Big Data storage and for the Information Security.

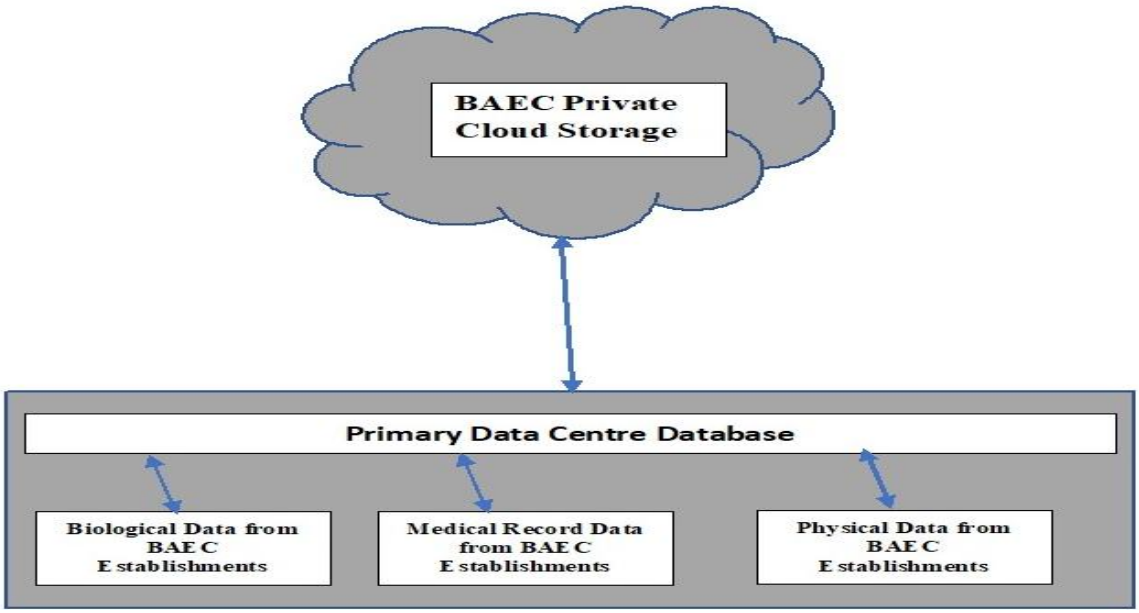

Fig. Private cloud storage for BAEC establishments to meet up the big data challenges

This is an ongoing research activity of Nuclear Cyber Security Division (NCSD). There are many ongoing future research are in place to do discuss more on the security of cloud in a virtualized environment and how to handle more in coming data into cloud regardless of private or public cloud. The authors of this work are also concerned to put effort in this issue as their future work.

1.5 Development and Expansion of Data Center Implementation in BAEC

M. S. Islam, K. N. S. Mitu, M. H. Ali, M. D. Hossain and M. S. Ahmed

The establishment and development of the Data Center at the head quarter of BAEC is currently going on. At this data center Infrastructure development of hardware level with server room, Network Server Installation and maintenance is already been completed. Relevant Software development activities are going on such pay-roll management system of BAEC HQ. This data center is very important for the commission as a part of digitalization for the commission's manual activities.

1.6 Implementation and Administration of E-Nothi System at BAEC and its Regional Offices

M. S. Islam, M. A. Uddin, M. D. Hossain and M. S. Ahmed

BAEC and its regional offices surrounds with many official administrative activities. Now in modern days, its very difficult to accomplish research and managerial administrative task by applying traditional manual nothi system. Its also consumes time, cost and visit. So, to reduce this hassle of manual nothi system, BAEC and its regional offices has implemented e-Nothi System under the supervision of Institute of Computer Science. The admin of E-Nothi system who is from the NCSD division of ICS at BAEC plays a vital role for implementing and administrating the system. The admin is responsible to join an employee to the system, can make resign the employee by taken order from higher authority, Nothi headings edit, any mistaken correction, training to employees etc related activities.

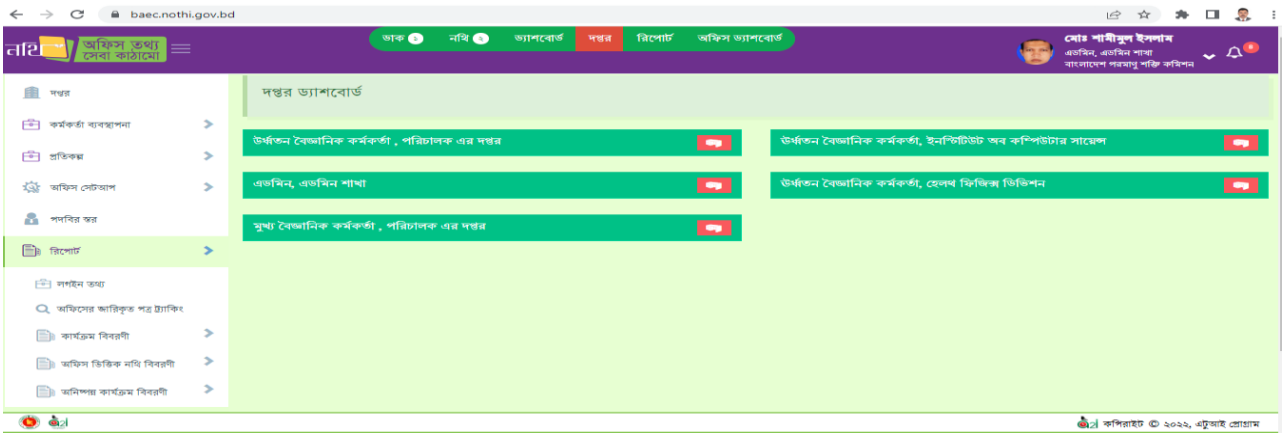

Fig. Administration panel of BAEC E-nothi system

2. Manpower Development/Training Programme(s)

Title of the event	Date	Place	No. of participamts
Computer Fundamental (Hardware, Operating System, MS-Word, MS-Excel, Internet Browsing)	19 Dec. 2021	ICS, AERE	25
e-Nothi Office Management	28-31 Mar. 2022	ICS, AERE	25

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

Name of the participant	Title of the event	Organizer	Date	Place
M. S. Islam, M. A. Uddin and Dr. M. D. Hossain	IEEE Computer Society Bangladesh Chapter Winter Symposium 2021	IEEE Computer Society Bangladesh	13-14 Nov. 2021	Zoom Platform
M. I. H. Showrov, M. S. Islam and M. A. Uddin	International Conference on Electronics And Informatics 2021	Bangladesh Electronics and Informatics Society	27-28 Nov. 2021	AEC, Dhaka
N. S. Mitu, Dr. M. D. Hossain	International Conference on physics -2022	Bangladesh physical society	19-21 May 2022	AEC, Dhaka
M. A. Uddin, M. S. Islam, M. I. H. Showrov	International Conference on physics -2022	Bangladesh physical society	19-21 May 2022	AEC, Dhaka
M. K. Islam, M. A. Amin, M. R. Islam, M. N. I. Mahbub, M. I. H. Showrov and C. Kaushal	2021 9th International Conference on Reliability, Infocom Technologies and Optimization (Trends and Future Directions) (ICRITO. pp. 1-9	IEEE Delhi Section	03-04 Sept. 2021	Amity University , India (Zoom Platform)
N. S. Mitu	"The forty-first International Conference on Machine Learning and Artificial Intelligence SGAI AI-2021"	British Computer Society, The Chartered Institute for IT	Dec. 14-16 2021	Zoom Platform
	BCS SGAI: 'Real AI 2021'	BCS SGAI: The British Computer Society Specialist Group on Artificial Intelligence	1 Oct. 2021	Zoom Platform.

4. Service Rendered

Name of service	Number/quantity of service provided
BAEC Domain based Official Email Services	104
Management Information System Administration Services	611
E-Nothi Administration Services	421
Consultation to the Scientists on the Computer and ICT	510
Wi-Fi Internet Security Services	525

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 preparation for BAEC employees/students/visitors Manpower development, IT training and consulting services to BAEC. The division conducts policy and ICT relevant national and international collaboration work with the ministry of Science & Technology.

Activities

1. Research and Development Work(s)

1.1 An Approach for the Normalization of Short Message Service to Detect Shorter Form of Words and Find out Actual Word

M. M. Alam, O. Goni, A. Shameem, S. Islam, N. K. Datta, S. Ahmed and G. Moazzam

Short Message Service (SMS) is one of the most popularly used services for communication between mobile phone users. Nowadays, different Instant Messaging (IM) apps such as messenger, WhatsApp, IMO, WeChat, etc., are becoming more and more popular. SMS communication has a general appeal, especially to the youth, because of its flexible use of alphanumeric characters, with little or no regard for orthographical and grammatical rules. However, this flexibility and freedom pose challenges for translating SMS into formal writing. To overcome this, a pre-processing step known as normalization is required. SMS language has, however, been recognized and accepted as a variant of natural language. Thus, there is compelling motivation to make it possible to build information-based services using SMS communication by normalizing the various forms in which the language appears. Therefore, we aim to find a suitable technique for conveniently normalizing the SMS.

1.2 Optical Fiber Network Route Planning, Design and Deployment for Atomic Energy Research Establishment

O. Goni, M. M. Alam and A. Shameem

A high-quality and correctly dimensioned network infrastructure is essential for all well-functional IT systems. An optical fiber-based network can ensure high speed as well as a high-quality network. To fulfill the current requirements of AERE (Atomic Energy Research Establishment), considering its smooth operation of high-speed internet service, the optical fiber-based network is the state-of- the-art network solution. An optical fiber network design refers to the specialized processes leading to a successful installation and operation of a fiber-optic network which includes determining the type of communication system(s) which will carry over the network, the geographic layout, the transmission equipment required, and the fiber network over which it will operate.

1.3 Implementation of Local Area Network (LAN) & Build a Secure LAN System for BAEC Head Quarter

O. Goni and A. Shameem

Network security is the process of taking physical and software preventative measures to protect the underlying networking infrastructure from unauthorized access, misuse, malfunction, modification, destruction, or improper disclosure, thereby creating a secure platform for computers, users, and programmes to perform their permitted critical functions within a secure environment. A local area network (LAN) is a computer network within a small geographical area such as a home, school, computer laboratory, office building or group of buildings. A LAN is composed of inter-connected workstations and personal computer swhich are each capable of accessing and sharing data and devices, such as printers, scanners and data storage devices, anywhere on the LAN. LANs are characterized by higher communication and data transfer rates

And the lack of any need for leased communication lines. A data network is an interconnected system of computers, peripherals and software over which data files and messages are sent and received. LAN is only one type of computer network. LAN define is Data com system allowing a number of independent devices to communicate directly with each other, within a moderately sized geographic area over a physical communications channel of moderate data rates. Fiber-optic communication is a method of transmitting information from one place to another by sending pulses of infrared light through an optical fiber. The light is a form of carrier wave that is modulated to carry information. Fiber is preferred over electrical cabling when high bandwidth, long distance, or immunity to electromagnetic interference is required. This type of communication can transmit voice, video, and telemetry through local area networks or across long distances. Optical fiber is used by many telecommunications companies to transmit telephone signals, Internet communication, and cable television signals. Researchers at Bell Labs have reached a record bandwidth distance product of over 100 petabit × kilometers per second using fiber optic communication. Communication between remote parties can be achieved through a process called Networking, involving the connection of computers, media and networking devices. When we talk about networks, we need to keep in mind three concepts, distributed processing, network criteria and network structure. The purpose of this Network is to design a Local Area Network (LAN) for a BAEC (Bangladesh Atomic Energy Commission) Head Quarter and implement security measures to protect network resources and system services. To do so, we will deal with the physical and logical design of a LAN. The goal of this Network is to examine of the Local Area Network set up for a BAEC HQ and build a secure LAN system.

1.4 Design and Deployment of Optical Fiber Network at Atomic Energy Centre, Dhaka

O. Goni and A. Shameem

Fiber-optic communication is a method of transmitting information from one place to another by sending pulses of infrared light through an optical fiber. The light is a form of carrier wave that is modulated to carry information. Fiber is preferred over electrical cabling when high bandwidth, long distance, or immunity to electromagnetic interference is required. This type of communication can transmit voice, video, and telemetry through local area networks or across long distances. Optical fiber is used by many telecommunications companies to transmit telephone signals, Internet communication, and cable television signals. Researchers at Bell Labs have reached a record bandwidth distance product of over 100 peta bit × kilometers per second using fiber optic communication.

To fulfill the current requirements of Atomic Energy Center, Dhaka considering its smooth operation of high speed internet service, optical fiber based network is the state-of-the-art network solution. An optical fiber network design refers to the specialized processes leading to a successful installation and operation of a fiber optic network which includes determining the type of communication system(s) which will be carried over the network, the geographic layout, the transmission equipment required and the fiber network over which it will operate. Atomic Energy Centre, Dhaka (AECD), considered as the pioneer institution of the Bangladesh Atomic Energy Commission (BAEC) is now one of its research establishments located at the core of Dhaka city was established in 1961 to carry out research and development activities in the field of nuclear science and technology for peaceful purposes. For that, here internet is essential. So optical fiber network design and deployment at Atomic Energy center is very important.

1.5 Implementation of Local Area Network in Thyroid Disease Management at INMAS, Dhaka

M. A. Shameem, O. Goni, M. M. Alam and M. Rahman

A Computer Network is an arrangement that enables two or more computers to communicate ("talk") to each other, sharing resources, information and services. This is basically implies that it is possible to reach every nook and corner of the state fast, easily, and comfortably. Same analogy can be extended to networks of computers. Network of computers implies linking computers through some kind of a communication links. This does not mean simply connecting the computers through some wires, instead it also includes the software that makes this hardware work, and also ensures that the information between these computers is exchanged without any loss or distortion. In short, it encompasses the whole gamut of hardware and software component that make a computer network operate. A Network of computer help exchange information between computers. LANs come in many sizes. A group of devices connected through a home internet connection is a LAN. Small businesses have LANs that connect a dozen or a hundred computers with printers and file storage. The largest LANs are controlled by a server that stores files, shares data between devices, and directs files to printers and scanners. Institute of Nuclear Medicine and Allied Sciences (INMAS), Dhaka is offering specialized medical services on following areas - Scintigraphy, Ultrasound & CD, PET-CT, Thyroid, Nuclear Cardiology, Nuclear Nephrology, In-Vitro, Therapeutic, etc. The Institute is run under Bangladesh Atomic Energy Commission (BAEC), under the Ministry of Science and Technology, Government of the People's Republic of Bangladesh. The slogan of "Digital Bangladesh" of the Government of Bangladesh has special significance for national development. Digital Bangladesh with Vision 2021 is a big impetus for the use of digital technology in the country. Hence, Thyroid Disease Management works of INMAS must be digitalized and managed by Local Area Network (LAN). For this, Thyroid Disease Management works will be maintained by Local Area Network. Smoothly at INMAS this paper describes the Implementation of Local Area Network in Thyroid Disease Management at INMAS, Dhaka.

2. Manpower Development/Training Programme(s)

Title of the event	Date	Place	No. of participants
Computer Fundamentals (Hardware Trouble-shooting, Operating System, MS-Word, MS-Excel, MS-PowerPoint and Internet Browsing)	19 - 23 Dec. 2021	ICS, AERE	25

3. Assemble, Troubleshooting, Repair and Maintenance of PC

Name of the institute	No. of PC
Institute of Nuclear Science and Technology (INST), Savar	4
Institute of Food and Radiation Biology (IFRB), Savar	5
Institute of Computer Science (ICS), Savar	11
Nuclear Mineral Unit (NMU), Savar	8
Central Administrative Division (CAD), Savar	9
Central Finance & Accounts Division (CF&AD), Savar	3
Scientific Information Unit (SIU), Savar	2
Institute of Radiation & Polymer Technology (IRPT), Savar	2
Training Institute (TI), Savar	3
Central Engineering Facility (CEF), Savar	4

5. Preparation of ID Card

SL. No	Name of the Institute	No. of Card
1.	Institute of Nuclear Science and Technology (INST),Savar	19
2.	Institute of Food and Radiation Biology (IFRB) ,Savar	18
3.	Institute of Electronics (IE) ,Savar	6
4.	Institute of Computer Science (ICS) ,Savar	5
5.	Central Engineering Facility (CEF) ,Savar	6
6.	Institute of Nuclear Mineral (INM) ,Savar	5
7.	Central Administrative Division (CAD) ,Savar	11
8.	Central Finance & Accounts Division (CF&AD) ,Savar	7
9	Institute of Energy Science (IES), AERE, Savar	4
10.	Institute of Tissue Banking and Biomaterial Research (TBBR), Savar	8
11.	Center for Research Reactor (CRR) , Savar	7
12.	Scientific Information Unit (SIU) ,Savar	1
13.	Institute of Radiation & Polymer Technology (IRPT) ,Savar	5
14	Training Institute ,(TI) Savar	1
15.	Medical Physics	10
16.	Daily Basis Employee, AERE,Savar	8
17.	Visitor Pass, AERE, Savar	100
18.	BAEC Head Quarter, Dhaka	10
19.	Atomic Energy Center, Dhaka	59
20.	Institute of Nuclear Medicine & Ailed Sciences (INMAS), Rajshahi	9
21.	National Institute of Nuclear Medicine & Ailed Sciences(NINMAS),Shahbag , Dhaka	32
22.	National Institute of Nuclear Medicine & Ailed Sciences (NINMAS), Dhaka	13

6. Internet Services

Assemble, Installation, New Connection, Fiber Splicing, Troubleshooting, Repair and Maintenance of Network devices/Internet Connection for ICS as well as other Institute of BAEC. Beside this, 852 Network devices/Internet Connection have been installing with configure Wi-Fi router, Switch, Replace Connector, Cabling, New Internet Connection, Fiber Splicing, Troubleshooting, Repair and Maintenance etc of during this period. A List of this activities for the period of Jul. 2021 to Jun. 2022 is given below:

Name of the Institute	No. of Card
Institute of Nuclear Science and Technology (INST), Savar	86
Institute of Food and Radiation Biology (IFRB), Savar	72
Institute of Electronics (IE), Savar	36
Institute of Computer Science (ICS), Savar	23
Central Engineering Facility (CEF), Savar	16
Institute of Nuclears (INM), Savar	14
Central Administrative Division (CAD), Savar	65
Institute of Energy Science (IES), AERE, Savar	13
Institute of Tissue Banking and Biomaterial Research (ITBBR), Savar	12
Center for Research Reactor (CRR) ,Savar	8
Scientific Information Unit (SIU), Savar	8

Name of the Institute	No. of Card
Training Institute (TI) ,Savar	42
Institute of Radiation & Polymer Technology (IRPT), Savar	15
Savar, Quarter	26
BAEC Head Quarter	306
Atomic Energy Center, Dhaka	110

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 The Necessity of Redundant Array of Independent Disks (RAID) Storage

N. K. Datta, A. A. Mamun and M. M. Alam

RAID is a technology that is used to increase the performance and/or reliability of data storage. The abbreviation stands for either Redundant Array of Independent Drives or Redundant Array of Inexpensive Disks, which is older and less used. A RAID system consists of two or more drives working in parallel. These can be hard discs, but there is a trend to also use the technology for SSD (Solid State Drives). There are two main reasons for RAID storage to work in this way: it increases data reliability and improves I/O (input/output) performance. That said, RAID storage isn't a perfect technology. Data loss can still occur when using it.

For an organization, databases are sensitive information containing employees' personal details and confidential information. To use the online services we are storing all our personal and sensitive data in the databases of these websites and applications. RAID combines physical disks into a single logical unit using special hardware or software. Hardware RAID solutions come in various styles. Some are built onto motherboards or add-in cards, for example, while others take the form of large enterprise NAS or SAN servers. RAID is traditionally implemented on servers but can also be used on work stations.

RAID levels: RAID 0 – striping, RAID 1 – mirroring, RAID 5 – striping with parity, RAID 6 – striping with double parity and RAID 10 – combining mirroring and striping.

There are many ways to get more out of your RAID system using non-standard configurations (up to RAID 51 and beyond), mainly as these can be used in tandem with other complex systems for significant efficiency and cost benefits. Given the highly complex nature of modern arrays, however, faults are still possible and the risk of data loss is higher than with traditional configurations. In these instances, the costs for businesses can be considerable, so be sure to weigh up the risks. Modern RAID arrays can also use multiple file systems, like BTRFS or ZFS at the hardware level, with NTFS or HFS layered over the top for application support via virtualization. RAID arrays are highly complex, and the challenges they present are intensified when they're used for business-critical functions within enterprise IT infrastructures, as availability and efficiency are essential.While useful in some scenarios, add-on technologies like virtualization and database applications can cause further costly complications in a failing system.

From a data recovery perspective, it would usually be necessary to reconstruct the RAID file system, bypass any physical failures and assess any virtualized architecture. This can make for a complex and time-consuming process, but recovery is possible with the right expertise.

1.2 Challenges and Approaches to Build a Sustainable Strong Nuclear Knowledge Base for the Country Started Construction of its First Nuclear Power Reactor

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

Today more than 10% of the world's electricity has been generating from about 450 nuclear power reactors operating in 31 countries. More than 50 power reactors are currently being constructed in 15 different countries. Among them Bangladesh, United Arab Emirates, Belarus, and Turkey started construction of their first nuclear power reactor. Additionally, about 30 countries are considering, and planning to start the construction of their first nuclear power reactor and more than 20 countries have expressed their interest to construct their first nuclear power reactor.

Countries that introducing nuclear power for the first time, have been facing almost similar key challenges. Building and maintain a knowledge base skilled workforce is one of the most important as well as consistent challenge. A strong nuclear knowledge management system that can be used for collecting, transferring, sharing, maintaining, preserving and utilizing knowledge and expertise can mitigate this milestone.

Developing and maintaining nuclear knowledge management for the country started construction of its first nuclear power reactor, carries yet diverse challenges. In this contest, the newcomer countries have the scope to gain knowledge and capabilities for the development of the nuclear knowledge base system, while vendors and other collaborator countries typically handover of the technical knowledge. This would be helpful to the working scientists and engineers to become knowledge providers that mitigate the knowledge gaps or knowledge loss. Another key challenge is to build up leadership for developing and maintaining knowledge management processes. A balanced combination of a top-down and bottom-up approaches is a key success to that direction. The data and record management, and overall management of knowledge over the technology lifecycle are also considerable agenda to develop a knowledge management system that ensure extremely widen accessibility and timely availability of data.

1.3 Securing Online Transaction Using Two-Factor Authentication

N. K. Datta, M. M. Alam, M. I. H. Showrov and A. A. Mamun

Nowadays, credit or debit card is a popular media that enables to purchase without carrying cash. Purchases in online and retailer stores, credit or debit cards are a common payment method. Since it involves with financial transactions so it is a desire need to confirm security. Identity theft is a very terrifying and real threat to everyone. There are many different types of threats to the cardholders. Majority of the information on credit/debit cards needed to make a purchase found directly on the card such as card number, three or four-digit security code, and expiration date. This valuable information can be viewed and even copied by someone such as a waiter or waitress whom we give the card to insert it into point-of-sale (POS) terminal machine. Sometimes we see that no password is required to accessing this card by POS terminal machine which is a direct threat to any cardholder. We aim to protect both the consumer and the credit card companies, which could be harmed financially. In the proposed work, we focus on the implementation of the two-factor authentication model that could protect someone from having a stolen credit card used.

1.4 Contents Management, Up-gradation and Uploading of the Official Web Portal of BAEC

N. K. Datta and M. M. Alam

A content management system (CMS) is a software application or set of related programmes 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 and M. M. Alam

BAEC maintain an employee database where all scientists, Engineers, Doctors and Geologists are on recorded according to institute. Newly appointed employees are added on the database and any up-gradation process is done in the nick of time. To track the employee faster, add new employees in simple steps, Update or Modify details easily, filter and track the employee faster. According to official order of BAEC any posting/newly recruitment/deletion of scientist are done at the due time on the "Directory of Personnel" of BAEC.

1.6 Management and Maintenance of Foreign Visit Records Web-Based Software of BAEC

N. K. Datta and M. M. Alam

Scientists of BAEC travel to abroad to attend in seminars, symposium and training for different official purposes. Foreign visit database aims to store overall information of each and every visit of the scientists. BAEC maintain a Foreign Visit database where all international Seminar/ Symposium/ Conference/ Workshop/ Meeting attended by the employee of BAEC are recorded. We provide technical support on any problem to enhance this activity.

There are features available to search list of event participation of any specific scientist or all the participants of any specific event. It is also possible to search participants or events of any specific month of any year. In any specific visiting history, it shows the name of the event, duration, participant's details including designation and institute. If any problem occurred during maintain the normal activities of this software we provide technical support.

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

Name of the participant	Title of the event	Organizer	Date	Place
M. M. Alam	National Conference on Physics - 2021	Bangladesh Physical Society	06-07 Aug. 2021	Dhaka, Bangladesh
N. K. Datta	International Conference on Electronics and Informatics 2021	Bangladesh Electronics and Informatics Society	27-28 Nov. 2021	AEC, Dhaka
	International Conference on 4th Industrial Revolution and Beyond (IC4IR) 2021	UGC	10-11 Dec. 2021	Hybrid Mode, Bangladesh

2. Service Rendered

Name of the services	Nature of service	Name of the services	Income
Management and Maintenance Official Web-portal of BAEC	ICT Based Expert Servicers	As per required	Free
Contents Uploading at the Official Web-portal.	ICT Based Expert Servicers	˜ 390	Free
Management and Maintenance Directory of Personnel of BAEC.	ICT Based Expert Servicers	˜ 80	Free
Management and Maintenance Foreign Visit Records Web-based software of BAEC.	ICT Based Expert Servicers	˜ 10	Free

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 has been started functioning in 3 Apr. 2008 at the Atomic Energy Research Establishment campus to build a favorable infrastructure for sustainable energy research and to promote the technological know-how in both renewable and non-renewable energy fields. The planned research and development activities are diverse and broad and the main objectives are to

- build trained and skilled manpower in different areas related to energy production
- undertake and promote R&D activities in the respective fields
- develop new technology for efficient and cost-effective energy production
- perform R&D in renewable sources, including hydrogen energy
- support academic activities, such as M.Sc., M.Phil., Ph.D. studies and carry out collaborative research programmes

Activities

1. Research and Development Work(s)

1.1 Source Term Calculation of Radiocesium Due to a Hypothetical Accident of TRIGA Research Reactor

M. A. Khaer, M. A. Hoq, M. T. Chowdhury and M. M. Rahman

The nuclear research reactors under their normal operation, release no massive quantity of radioactivity to the surroundings. However, under accidental situations with severe core damage to the nuclear reactor, some meaningful quantity of radio nuclides may be released into the atmosphere. Radio nuclides that are genuinely anticipated to be emitted through the stack can bring about direct radiation exposure to the population and the atmosphere in downwind distance and that also be deposited on ground and vegetation. In this work, we focused on source term calculation of ^{134}Cs and ^{137}Cs are predictable to be released considering hypothetical accident of TRIGA Mark-II research reactor, Atomic energy research establishment (AERE), Savar, Dhaka, Bangladesh. Higher activity was obtained by ^{137}Cs due to its longer half-life compared to ^{134}Cs.

1.2 Radiological Dose Assessment of Radiocesium using Gaussian Plume Model (GPM)

M. A. Khaer, M. A. Hoq, M. T. Chowdhury and M. M. Rahman

In this study radiological dose assessment of ^{134}Cs and ^{137}Cs radionuclides due to a postulated accident of the TRIGA Mark-II research reactor at AERE, Savar, Dhaka, Bangladesh was performed. Due to most responsibility of radiation exposure to the general public the radionuclides ^{134}Cs and ^{137}Cs were selected. The HotSpot 3.1.2 code was used for the dose calculation which was created to equip emergency response personnel and planners with a fast, field-portable set of software tools for evaluating incidents involving radioactive material. The dose values of TEDE (Sv), Ground Deposition (KBq/m^2) and Ground Shine dose rate (Sv/hr), and Time Integrated Air Concentration (Bq-Sec)/m^3 were calculated for an 80 km radius from the reactor site. An assessment for organ doses of ^{134}Cs and ^{137}Cs as a function of distance was also performed. Local meteorological data were collected from Bangladesh Meteorological Department and the data were analyzed for the dose assessment. Considering all directions, wind from the south ("S") direction was dominant. From the calculation, a higher dose for ^{137}Cs was obtained compared to ^{134}Cs due to its higher fission yield and longer half-life.

1.3 Activity Concentration Analysis for Coolant Impurities in BAEC TRIGA Research Reactor

M. A. Hoq, M. A. Khaer, M. T. Chowdhury and M. M. Rahman

The Bangladesh Atomic Energy Commission (BAEC) TRIGA Research Reactor is a unique nuclear installation in Bangladesh. During normal operation of the reactor various radionuclides are generated by the fission of U-235 and the neutron activation of the surrounding material which includes the impurities in the

reactor pool coolant water. Although the water of the primary cooling system is demineralized, it still contains a small fraction of impurities, which is activated by the neutron interaction. Coolant impurities are naturally occurring nuclides that remain after purification of coolant water for use in a reactor like BTRR. There may exist numerous activated water impurities in the reactor coolant as like Na-24, Cl-38, Mg-27 and Si-31. Radiologically one of the most significant radionuclides typically generated in the process of impurity activation is Na-24. The present study focused on the estimation of activity concentration for Na-24 present in water coolant produced as a result of ^{23}Na (n,γ) ^{24}Na reaction. The obtained result of 8.83 x 10^{-3} μCi/cm^3 makes sure that the estimated activity level for Na-24 at 2.4 MW reactor power was within the safety limit. The coolant flow rate and the coolant temperature rise through the reactor core regarding different reactor power level were also measured during the estimation process. Concerning radiological safety issues of the research reactor the assessment performed under the present study has an implication.

1.4 Radiological Safety Assessment Due to ^{41}Ar and ^{16}N Airborne Release from the TRIGA Research Reactor

M. A. Hoq, M. A. Khaer, M. T. Chowdhury and M. M. Rahman

The main focus of the present study was to estimate activity concentration of ^{41}Ar and ^{16}N airborne released from the Bangladesh Atomic Energy Commission (BAEC) TRIGA research reactor (BTRR). The reactor is a tank type research reactor with a license to operate at a maximum steady state power of 3MW (thermal) and can also be pulsed up to a peak power of about 852MW. Concerning radiological safety, it is required to estimate activity concentration due to radionuclides released in the airborne from the operating reactor. The primary activation product of interest in terms of airborne release from the reactor is ^{41}Ar and ^{16}N which are readily released through the reactor hall ventilation system. Initially ^{41}Ar and ^{16}N are produced from irradiation of dissolved air in the primary water which eventually transfers into the air in the reactor bay. The estimation of radiological concentration distribution was performed based on the fraction of ^{41}Ar and ^{16}N released to the environment through the reactor stack. The estimated concentration of ^{41}Ar in the reactor bay is 9.43 x 10^{-4} Bq/cm^3, with a stack effluent release rate of 4.43 x 10^3 Bq/Sec and a volume flow rate of 4.7 x 10^6 cm^3/sec. The estimated ^{16}N activity concentration values with 500 kW reactor power at the reactor core region was 7.40 x 10^5 Bq/cm^3 and at the bay region was 3.39 x 10^{-5} Bq/cm^3. Results show that the estimated activity level for ^{41}Ar and ^{16}N are well below the maximum permissible concentration limit set by the regulatory body.

5. Radiological Dose Assessment Using Gaussian Plume Model and Lagrangian Gaussian Plume Model

M. A. Khaer, M. A. Hoq, M. T. Chowdhury and M. M. Rahman

We studied the radiological safety and emergency response of the VVER-1200 type nuclear power plant using the RASCAL 4.3 code for INES levels 5, 6, and 7 reactor accidents due to SBO concomitant with LOCA for both dry and rainy seasons. The simulation was performed using Gaussian Plume Model and Lagrangian Gaussian Plume Model, respectively. The meteorological data for dry and rainy seasons were considered for the RNPP site of Bangladesh. The amount of total radioactivities of radiological equivalence to I-131 that released to the atmosphere for INES levels 5, 6, and 7 nuclear reactor accidents were 4011.6 TBq, 25110 TBq, and 129650 TBq, respectively. Radiological doses such as TEDE, Thyroid CDE and Inhalation CEDE were evaluated for 40 km radial distance from the reactor site. The total effective dose for RASCAL code predicts the higher dose value during the rainy season compared to the dry season. In the rainy seasons, TEDE was very high about several ten times of permissible limit within 16 km radial distance. Therefore, immediate radiological protective measures are required to be implemented based on the emergency response plan of the local regulatory authority.

2. Seminar/Symposium/Conference/Meeting Attended

Name of the participant	Title of the event	Organizer	Date	Place
Dr. M. M. Rahman	Advanced Instructor Training Course 2021-Reactor Engineering	JAEA	12-21 Jul. 2021	Virtual platform
	Consultancy Meeting on RIGA Research Reactor Fuel Supply	IAEA	22-24 Nov. 2021	Virtual platform
Dr. M. T. Chowdhury	Training on E-Nothi Management	ICS, AERE	28-31 Mar. 2022	ICS, AERE
	NIS and Good Governance related Training	BIM	22 Jan. 2022	Zoom platform
	Workshop on awareness on what to do to meet the challenges of the Fourth Industrial Revolution	BAEC	14 Jun. 2022	BAEC HQ
	International Conference on Physics -2022	BPS	10-21 May 2022	AECD
Dr. M. A. Hoq	Seminar on Radiological Dose Assessment Using Lagrangian Puff Model for Postulated Severe Accidental Conditions of VVER-1200 Type Reactor	ICS, AERE	13 Jun. 2022	AERE, Savar
	Seminar on Radiological Dose Assessment Using Gaussian Plume Model for Postulated Severe Accidental Conditions of VVER-1200 Type Reactor	ICS, AERE	24 May 2022	AERE, Savar
M. A. Khaer	Training on Feasibility Study for Development Project	BIM	20-21 Mar. 2022	Dhaka
	International conference on Physics	BPS	19-21 May 2022	Dhaka
	Training on E-Governance & Innovation in Public Services	BAEC	31 Jan. 2022	Dhaka
	Training on Complaint Redressal System and GRS Software and Service Delivery Commitment	BAEC	6 Jun. 2022	Dhaka
	Seminar on Radiological Dose Assessment Using Gaussian Plume Model and Lagrangian Gaussian Plume Model for Postulated Severe Accidental Conditions of VVER-1200 Type Reactor	IES, AERE	25 Apr. 2022	AERE, Savar

3. Collaboration Work/MoU

3.1 Special Allocation Project

Assessment of Radiological Safety due to Accidental Release of Radionuclides from VVER-1200 Type Reactor, Principal Investigator: Dr. Mohammad Mizanur Rahman, Associate Investigator: Dr. Md. Ajijul Hoq, (Group ID: Phy's 623, Financial year: 2021 – 2022).

3.2 **IAEA CRP Project (J15002)**

Application of Dose Assessment Codes for Nuclear and Radiological Emergency Preparedness and Response of Nuclear Installations of Bangladesh, Chief Scientific Investigator: Dr. Mohammad Mizanur Rahman, Director, IES (Contract No. 23876/RO, Cycle: Jan. 2020 - Dec. 2022, Status: On-going).

3.3 **IAEA TC Project (BGD1013)**

Strengthening Capacity in the Design and Development of Spent Fuel Storage and Reactor Safety Testing Laboratory,

Counterpart: Dr. Mohammad Mizanur Rahman (Cycle: 2018-2019, Statue: On-going).

3.4 Memorandam of Understanding (MoU)

A MoU (Memorandum of Understanding) between the Institute of Energy Science, Bangladesh Atomic Energy Commission, Bangladesh and the Institute for Integrated Radiation and Nuclear Science, Kyoto University, Japan has been signed by the BAEC and the Kyoto University.

INSTITUTE OF RADIATION AND POLYMER TECHNOLOGY (IRPT), AERE

Objective/Introduction

- 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 programmes, 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. Physio-mechanical property of unidirectional Jute Fiber Reinforced Polypropylene and Linear Low-Density Polyethylene based composite were determined and impact of dye observed.

1.2 Development of Advanced Materials for Biomedical, Environment Application

Different types of hydrogels were prepared for biomedical application and heavy metal removal.

1.3 Use of Radiation, Chemical and Microbiological Tools for Water Treatment for Different Uses

Physio-chemical and microbiological quality assessment of surface water of Turag River, Buriganga river and different aquaculture pond in Savar, Dhaka was conducted. Gamma irradiation was used for the treatment of polluted river water. Research was conducted to investigate naturally occurring bacterial strategy in degrading or detoxifying heavy metals of the Buriganga River. Study was conducted in a view to removal of chromium and lead from paint industry effluent by naturally occurring bacteria. Biodegradation capability of pesticide resistant naturally occurring bacteria to breakdown the hazardous residual pesticide was also observed.

1.4 Dye Sensitized Solar Cells (DSSCs) Were Constructed With TiO_2 and ZnO Nanoparticles and The Effect of gamma (γ) Radiation on Them Was Determined

2. Manpower Development and Training Programme

speaker	Title of the event	Date	Place	No. of participant
M. M. Haque	Polymer Surfactant Interaction	23Sept., 2021	IRPT, AERE	15
	Co-60 Gamma Irradiator Pool Water Quality Monitoring	03Apr., 2022	IRPT, AERE.	14

speaker	Title of the event	Date	Place	No. of participant
Dr. R. A. Khan	Biodegradable Packaging Materials	17 Jan., 2022	IRPT, AERE	16
M. Razzak	Accreditation of Co^{60} Gamma Irradiator Facility	29Mar., 2022	IRPT, AERE	16
M. Z. I. Mollah	Co^{60} Gamma Source Pool Water Corrosion & its Prevention	12 Jun., 2022	IRPT, AERE	16

3. Seminar/Symposium/Conference/Meeting Attended

Name of participant	Title of the event	Organizer	Date	Place
Dr. R. A. Khan	World EXPO 2020 in UAE	BAEC	25-28 Jan. 2022	UAE, Dubai
M. Z. Hasan	E-governance and Innovation	BAEC	26 Mar. 2022	BAEC DQ
M. M. Haque	Right to Information; GRS System and GRS Software; Citizen Charter	SID, BAEC	06 Jun., 2022	Head Office, BAEC
M. M. Hossain	E-governance and Innovation	PDD, BAEC	23 Jun. 2022	BAEC DQ
M. H. Ali	Computer Fundamental (Hardware, Operating System, MS-Word, MS-Excel, Internet Browsing)	ICS, AERE	19-23Dec. 2021	ICS, AERE

4. Repair, Maintenance and Renovation Works

- Mechanical problem of IRPT Co-60 Gamma plant was resolved and plant started working properly
- Mechanical problem of source tank was removed
- The capacity of the demineralized water treatment plant is 1000L/hr which was checked properly
- Repair and maintenance work were done for Heat Press Molding Machine of Composite Lab of IRPT

5. Stakeholder Seminar/Meeting Arranged

Several stakeholder meetings were held with different companiese.g.PranAgro Ltd., Square Food and Beverage Ltd. Etc. for promoting irradiation services to these stakeholders between Jul. 2021 to Jun. 2022 at IRPT.

Title	Place	Date
Experience Sharing Meeting with Stakeholders	IRPT, AERE, Savar	17 Oct., 2021
Experience Sharing Meeting with Stakeholders	IRPT, AERE, Savar	7 Jun., 2022

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, family planning kits, eye ointment, mannitol, PEG-600, bacitracin Zn etc.

Number of organization	Nature of sample/service	Total number/quantity of sample	Revenue income
4 companies (26 consignment)	Food Irradiation	181.7 Ton	61,77,820/-

5 companies (20 consignment)	Medical Products	5080cft	27,51,800/-
8 companies (30 consignment)	Pet Food	63.2 Ton	22,10,417/55
Total			1,11,40,037/55

INSTITUTE OF NUCLEAR MINERALS (INM), AERE

Introduction

Institute of Nuclear Minerals is mainly engaged in nuclear mineral exploration programme in the potential area of Bangladesh. INM is responsible to explore atomic minerals containing uranium, thorium and other associated valuable metals in different prospective zones of Bangladesh together with nuclear technology transfer to different national, international mining companies, Government organizations for mineral resource exploration and development. Besides INM is now working on geochemical and mineralogical characterization of radioactive rock and sediment, radon survey in potential radioactive anomalous zone of Bangladesh and geoenvironmental studies. In addition, this institute provided geophysical borehole logging services as per demands of different organizations/companies.

Activities

1. Research and Development Work(s)

1.1 The use of Textural Parameters of Sand in Studying The Characteristics and Depositional Processes of The Chalti River, Sunamganj, Bangladesh

F. Deeba, N.T. Dina, M.G. Rasul, M.Z. Kabir, M. Rajib, S.C. Das and M.S Islam

Grain size distribution is one of the most significant properties of sediment particles because sizes of particles or grains in a particular deposit reveal their hydrodynamic energy and transportation processes. Consequently, grain size analysis reveals some essential evidences of transportation and depositional conditions. This study presents a detailed textural and heavy mineral study of sediments from Chalti river of Sunamganj district to explore the depositional history of source rock complexes, mode of transportation and depositional environment. 12 (Twelve) samples were selected for heavy mineral separation and grain size analysis. Grain size analysis was carried out employing "Restch ASTM type Sieving machine" and grain size statistics (e.g., mean, Skewness, sorting, and Kurtosis) were processed through GRADISTAT software. Bromoform ($CHBr_3$) with specific gravity 2.88 was used for heavy mineral separation. Heavy mineral contents in the studied samples range from 2.53% to 65.63%, with an average value of 20.86. The textural studies clearly established that the sediments were fine to coarse grain sand (graphic mean -0.22Φ to 2.74Φ), moderately to moderately well sorted (standard deviation 0.53Φ to 1.31Φ), skewness ranges from -0.39Φ to 0.44Φ, and Kurtosis varies between 0.59Φ to 2.28Φ. These data strongly suggest a fluvial or tidal environment of source material.

1.2 Distribution and Characterization of Heavy Minerals in the Jadukata River Sand, Sunamganj, Bangladesh

F. Deeba, N.T. Dina, M.G. Rasul, M.Z. Kabir, M. Rajib, S.C. Das and M.S Islam

The river and drainage systems within Bangladesh are extensive, carrying large quantities of sandy sediments to the coastal regions. The alluvial sediments contain both light and heavy minerals (HMs). HMs are generally deposited on the bed of the river systems forming HM-rich sand bars. The Jadukata river is situated at Tahirpur upazilla of Sunamganj district, which is originated from Meghalaya ranges of India. An attempt has been made under this research work to determine the kinds and amounts of heavy minerals in the sand bar in order to infer the nature of source rock complexes as a part of exploration activity of the institute. Heavy mineral separation was performed by using Bromoform ($CHBr_3$, specific gravity 2.88). Samples from 20 locations along Jadukata river from upstream to downstream was found to contain different heavy minerals concentration with a range of 0.85 to 9.4%. The heavy mineral assemblage in the river sand is granet, zircon, tourmaline, rutile, staurolite, epidote, sillimanite with opaque minerals.

1.3 Characteristics of River Bar Sand in the Jadukata River, Sunamganj, North-East Bangladesh: An Implication for Depositional Phase and Environment

N. T. Dina, F. Deeba, M. G. Rasul, M. Z. Kabir, M. Rajib, S. C. Das and M. S. Islam

Textural evaluation of Jadukata river sand based on the grain size analysis has been carried out in order to identify its textual signatures and depositional environment. The main objective of this work was to interpret the mechanisms of sediment deposition by applying comprehensive statistical analysis of sediment grain-size distributions, using various methods such as bivariate scatter plots, box-plots, probability accumulation graph and CM plots. 20 (Twenty) loose and friable sandstone samples were selected for sieving. Various statistical parameters (mean, median, sorting, skewness and kurtosis) are measured from sieved data using GRADISTAT software. Graphic means, standard deviation and skewness for these analyzed sand ranges from 2.48Φ to 0.43Φ, 0.64Φ to 1.58Φ and -0.31Φ to 0.18Φ respectively. The graphic mean of the studied samples corresponds fine to very coarse grained sand class and poorly to moderately sorted sand. A mixture of negative to positive skewness indicates a fluctuating energy state of the depositional media. According to genetic sorting classification based on bivariate plots, it is assumed that the sedimentary depositional environment in the study area has been mainly controlled by fluvial activities.

14 Assessment of Physicochemical Properties of Someshwari River Water in Netrokona District

N.T. Dina, F. Deeba, M. G. Rasul, M. Z. Kabir, M. Rajib, S. C. Das and M. S. Islam

The Someshwari river is located in the north eastern part of Bangladesh. It starts from Nokrek Mountains, Meghalaya and enters into Bangladesh through north eastern part near Bijoypur area of Netrokona district. The river is mainly sand bedded rivers and the quantity of sediments carried by these rivers is tremendous and the sediments contain large quantity of sandy materials, which are generally laid down in the beds of the river, forming sand bar. This study was conducted to assess the physicochemical properties of surface water collected from eleven different sampling points in Someshwari river of Netrokona district to delineate the water quality of this river. The physicochemical properties like temperature, pH, electrical conductivity (EC), total dissolved solid (TDS) and salt content (%) of the surface water were measured on site by portable HANNA instrument (HANNA HI 98190 for pH and HANNA-HI 98192, Romania) for temperature, EC, TDS and salt content Hanna Instruments, Woonsocket, USA). pH, EC, TDS and salt content ranges from 7.51 to 8.75, 25.02 to 86.89 µs/cm, 10.95 to 43.05 ppm and 0.1 to 0.2 % respectively, which is within the WHO (2011) and DoE (1997) standard limit. Pearson correlation analysis showed a significantly positive correlation between EC, TDS and salt content.

1.5 Radioactive and Rare Earth Element (REEs) Exploration at Someshwari River, Netrokona, North-East Bangladesh

M. Rajib, M. G. Rasul, M. Z. Kabir, F. Deeba, N. T. Dina, S. C. Das, M. Asaduzzaman and M. J. Uddin

A week-long geological field survey was conducted at the flood plain area of Shomeswari River of Netrokona district as part of exploration activity of the institute, to investigate the presence of radioactive and rare earth element containing materials in the transported sediments. To find out the source of radioactivity and rare earth element containing minerals in the river-born sediments, the survey was conducted using portable gamma-ray spectrometer (Gamma Surveyer II), Geiger counter (BR-9C series radiation detector) and Individual Dose Rate Meter (FS2011). Uranium (U-238), thorium (Th-232) and potassium (K-40) was determined in-situ in as many as 15 sampling points in between latitude 25.1038 to 25.18206 and longitude 90.65601 to 90.66215, as measured by Garmin ETREX 22X GPS system. Hand auger system were used to obtain samples from 0-5 feet depth at each location, whereas, two drill holes of appx. 30 feet deep were made to obtain samples from various depth. In-situ radioactivity and corresponding dose rates was recorded. Results showed the presence of 1.85-29.39 ppm of U-238, 4.0-52.06 ppm of Th-232, 0.16-0.73% of K-40 were measured in the samples with corresponding dose rates of 0.07-0.57 µSv/hr. Samples of more than 1 kg from each location were taken to measure the mineralogical composition, elemental concentration and radioactivity using various laboratory techniques.

1.6 Calibration of Auxiliary Seismic Station of CTBTO (AS-007, BRDH)

M. Rajib and M. G. Rasul

The Comprehensive Test-Ban Treaty Organization (CTBTO) operates many seismic stations around the

world to observe artificial earthquakes generating from nuclear tests. Auxiliary Seismic Station (AS007) at Bariadhala (BRDH), Chattogram is such type of station in Bangladesh that receives the seismic data from the region. AS007 is equipped with the Guralp computer system that is connected with National Data Center (NDC) located in Atomic Energy Center, Dhaka of Bangladesh Atomic Energy Commission through the VSAT communication system. The station has been accredited as an internationally certified station on 8th Dec., 2011. The station was later upgraded in Sept. 2017. The seismic station AS007 was established to monitor the activities of nuclear testing through earthquake occurrence in the region. At the same time, it can be utilized for natural earthquake monitoring and subsurface geological information. To obtain the related data for those application, AS-007 needs to be regularly calibrated, usually twice a year. This calibration is also necessary for the International Data Centre (IDC) to effectively use the captured data from AS-007. As part of the first scheduled calibration activity of 2022, calibration process was run during 24-27 Jun. with the help of support team of CTBTO. The calibration results were obtained according to the site of BRDH as BHE-0.3059351, BHN-0.4444493 and BHZ-0.3075589. Among them, the channel BHN was found not in spec and therefore, reported to CTBTO for correction.

1.7 Study on the Deterioration of Archeological Buildings at Panamnagar, Narayanganj, Bangladesh

M. Rajib and A. Z. Showly*

*Department of Archaeology, Jahangirnagar University, Savar, Dhaka

Simultaneous field observation and laboratory techniques to analyze deteriorating materials at heritage buildings were conducted probably for the first time for any archaeological ruins in Bangladesh. The 15 to 19 century old buildings at Panamnagar, also known as Panam City located at Narayanganj district, were investigated through in-situ weathering characteristics to find out the possible relation of deterioration due to surrounding environmental parameters. Laboratory techniques like X-ray diffraction (XRD) for salt identification, Scanning Electron Microscopy (SEM) for elemental analysis and major cations and anions in water by Atomic Absorption Spectrometry (AAS) were performed for several brick powder and water samples. Results shows the presence of thenardite, gypsum and nahcolite as major salts responsible for deteriorating the building materials. Results of environmental parameters such temperature, rainfall, relative humidity were also analyzed to obtain possible relation of generating such salts on the buildings. Results from physical and chemical parameters of water bodies, mineralogical and elemental analysis of weathering materials were conclusive to the fact that deterioration occurred primarily due to formation of biological species on the ancient walls which may have grown due to changing environmental parameters.

1.8 Microscopic Study of Heavy Minerals to Validate the Analysis of Multispectral Satellite Imagery

M. Rajib

For identifying heavy minerals in any area, standardized hyperspectral analysis using Landsat satellite data and Environment for Visualizing Images (ENVI) software is a useful tool. Field verification of mineral resources identified on the satellite image at Teknaf Upazilla has been performed to assess the accuracy of classification. The survey encompasses both the back dune and fore dune area along the coast of the study area. Separated heavy minerals of total 38 surface samples were analyzed (18 samples from Shilkhali and 20 samples from Lombori) were investigated under an optical polarized microscope (Optima ML9000) by applying the grain counting technique. Temporary slides were prepared for this analysis to identify individual minerals based on their optical properties. According to the standard procedure, mineral grains were counted from 10 views for each slide (i.e., samples) with at least 100 grains in each view, which leaves a total minimum of 1000 grains for each sample. Adjusting with the specific gravity, the concentration of identified minerals was calculated as weight percentage.

1.9 Characterization of Madhupur & Barind Clay for Assessing the Suitability for Disposal of Radioactive Wastes: A Literature Review

M. Moniruzzaman*, S. C. Das and M. G. Rasul

Current research involves literature review for the characterization of Madhupur and Barind clay, widely known as Plio-Pleistocene terrace deposits, for assessing the suitability for disposal of radioactive wastes. Around 20 literatures were studied with the topic concerning mainly on geology, sedimentology, geochemistry and geotechnical properties. Atterbrg's limits apparatus, direct shear test apparatus, XRD, SEM,

XRF etc. were used as major characterizing tools. The thickness of both the formations vary approximately 10 to 20 m from place to place. The grain size distributions study shows that the percentage of clay, silt and sand varies 19-83%, 2-81% and 4-60% for Madhupur clay and 29-59%, 24-36% and 15-47% for Barind clay, respectively. From the clay mineral study, it was found that Madhupur clay contains kaolinite (50%), illite (40%) and illite-smectite (10%) whereas, Barind clay is dominantly illite type (77-89%) along with kaolinite (11-23%) and occasional presence of smectite (4-5%). Though Madhupur clay have little smectite-illite content (10%) but those might be investigated to decipher geotechnical properties i.e. hydraulic conductivity, swelling, elasticity etc. Moreover, the studied properties of Madhupur and Barind clay were compared with the Boom Clay of Belgium, which considered potential host rock for the disposal of medium- and high-level long-lived waste in Belgium. Therefore, it can be concluded that clay might be used as host rock for geological disposal of radioactive wastes

1.10 Measurement of Near Surface Shear Wave Velocity at AERE Campus Using RAS 24 Exploration Seismograph (Seistronix): Implication for Delineation of Subsurface Geology for Geotechnical Purposes

S. C. Das*, M. Moniruzzaman, M. G. Rasul, M. Z. Kabir, F. Deeba, M. Rajib and N. T. Dina

The current study deals with the delineation of subsurface geology of AERE complex adjacent to INM building by measuring the shear wave velocity (Vs) of subsurface geological materials up to 30m depth following multi-channel analysis of surface wave (MASW) method using RAS 24 exploration seismograph for geotechnical purpose. The MASW test demonstrates Vs30 values of the studied part varying from 239 m/s to 268 m/s averaging 253 m/s. Three geological formations such as Alluvium deposits, Madhupur Clay and DupiTila Formation have been demarcated from the Vs profile of MASW test. Moreover, the subsurface soil has been classified based on National Earthquake Hazard Reduction Programme, USA (NEHRP) and Bangladesh National Building Code (BNBC) as stiff soil/Soil type D ((Vs30 = 180-360 m/s). The results coincide with the near surface Vs of Dhaka city considering the engineering geomorphic unit and the conventional lithostratigraphy of the Madhupur area. The results will be helpful in deciding any kind of geotechnical construction in AERE. However, extensive investigation throughout the AERE complex will give complete picture with subtle variation.

2. Manpower Development and Training Programme

Name of the speaker	Title of the event	Date	Place	No. of Participant
Dr. Eiji Sasao	INM Invited Lecture on Radioactive waste disposal in Japan, especially focused on geological disposal of high-level radioactive waste	6 Oct. 2021	INM, AERE (virtual)	26
	"Solid phase characterization of lanthanide oxide and hydroxides"	18 Jan. 2022	INM, AERE	10
	"Characterization of Madhupur & Barind Clay: A literature review"	12 Apr. 2022	INM, AERE	12

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

Name of the participant	Title of the event	Organizer	Date	Place
M. G. Rasul, M. Z. Kabir, F. Deeba, M. Rajib, N. T. Dina and S.C. Das	National Seminar on Geoscience for Sustainable Development	Geological Survey of Bangladesh	13-15 Dec. 2021	Shilpokala Academy, Dhaka
	4th International Conference on Physics (ICPSDT-2022)	Department of Physics, CUET	22-23 Jan., 2022	CUET, Chattogram (Virtual)

M. Z. Kabir and F. Deeba	e-Nothi office Management	Institute of Computer Science, AERE	28-31 Mar. 2022	AERE, Savar
F. Deeba	APAMS software training for the Focal point of BAEC	BAEC with association of MOST	30 Dec. 2021	Zoom Platform
	NDC Capacity Building: Access and Analysis of waveform IMS Data and IDC Products	CTBTO	31 Jan-04 Feb 2022	WebEx video-conferencing
Dr. M. Rajib	CTBT: Science and Technology Conference 2021 (SnT2021)	CTBTO	28 Jun.-2 Jul. 2021	Vienna, Austria (Virtual)
	Mujib100 Idea Contest 2021 on 4th Industrial Revolution	University Grants Commission, Bangladesh	10 Dec. 2021	Bangabandhu International Conference Center, Dhaka
	Workshop on 4th Industrial Revolution	BAEC	14 Jun. 2022	BAEC HQ
M. Moniruzzaman	Training workshop on "E-Governance & Innovation in Public Services"	Innovation Team of BAEC	26 May 2022	BAEC HQ
M. Moniruzzaman and S. C. Das	Annual Delta Conference	The Delta Study Center	28 May 2022	Department of Geology, DU
S. C. Das	Day long training workshop on "E-Governance & Innovation in Public Services"	Innovation Team of BAEC	31 Jan. 2022	BAEC HQ
	Training on "Blue Economy"	NAPD, Ministry of Public Administration	19-23 Jun. 2022	Dhaka

4. Collaboration Work/MoU

4.1 Special Allocation Project

- Title: Determination of the Characteristics of Crystalline Basement Rocks from Maddhapara Granite Mine Area for Hydrogeochemical and Geotechnical Investigation; Principal Investigator: Mohammad Zafrul Kabir, Chief Geologist, Co-Investigator: Md. Shafiqul Islam, Principal Engineer; Funding amount- 2,50,000/- (Two lakh fifty thousand) only. Year: 2021-22.
- Title: Environmental Radiation Measurement and Health Risks due to Natural Radionuclides and Heavy Metals at the Southeastern Coastal Area of Bangladesh; Principal Investigator: Farah Deeba, Principal Geologist, Co-Investigator: Nafisa Tamannaya Dina, Geologist; Funding amount- 2,50,000/- (Two lakh fifty thousand) only. Year: 2021-22.

4.2 Research Collaboration with Universities

Title: Paleoclimatic conditions during deposition of the Surma Group in the Chittagong Tripura Fold Belt, Bengal Basin; Principal Investigator: Dr. Rumana Yasmin, Associate Professor, Department of Geological Sciences, Jahangirnagar University; Co-Principal Investigator: Mohammad Zafrul Kabir, Chief Geologist; Started on Mar., 2022.

5. Repair, Maintenance and Renovation Works

Institute of Nuclear Minerals is equipped with various instruments required for geological and geophysical exploration. These are: Borehole geophysical logging system, Gamma surveyor, Scintillation counter, Radiation monitor, Shallow seismic survey meter, Portable survey meters, Hand auger system, Polarizing Microscope, Electronics balance, Sieve shaker, Laboratory oven, Fume hood etc. All of these equipment needs maintenance to work properly as and when required. Primary mechanical, electrical and electronic repair and maintenance works were conducted during the reported time. Besides, all types of small civil

renovation and maintenance works, repair and maintenance of computer systems were also done to run all the equipment smoothly.

6. Others

M. G. Rasul, M. Z. Kabir, F. Deeba, M. Rajib, N. T. Dina and S. C. Da, participated in Carrier Festival and Research Fare, organized by Faculty of Earth and Environmental Sciences, University of Dhaka, 17 May, 2022 held at TSC, University of Dhaka.

INSTITUTE OF NUCLEAR MEDICAL PHYSICS INSTITUTE (INMP), AERE

Introduction

The number of cancer patients in the world is increasing at an alarming rate, Bangladesh is not an exception here. Regarding this scenario, the project of establishing a dedicated cancer research institute had commenced on 2013 which evolved into its full-fledged version on 2018. Since then, Institute of Nuclear Medical Physics is committed to provide standard treatment services with a low cost as well as cutting edge-research in the field of this insidious disease. It is also developing manpower, expert Nuclear Medical Physicist and Technologist in the respective field with proper academic and practical training courses. Currently, at INMP, we provide cancer treatment with Radiotherapy with a high quality LINAC machine and the diagnostic procedure through PET-CT and Ultrasound machine. Scientist, engineer and doctor – endeavors from this combined 'trio' at INMP have developed a multidisciplinary research environment on different branches of a cancer treatment facility. Every year number of research-articles are published in high-impact factor journals across the globe. Several group of research students from different universities of Bangladesh are engaged in collaborative research works all the year around herte.

Objective

- To provide patient's services for cancer detection and radiotherapy through medical physics techniques.
- To build up skilled radiation oncologists, medical physicists and technologists through academic and specialized training.
- To establish a Cyclotron facility for the production of isotopes, MRI and Brachytherapy facility in order to clinical use and multidisciplinary research.

Activities

1. Quality Control (QC)

Name of equipment	Name of parameter	Times	Using apparatus
LINAC	Absolute Dosimetry	12	Water phantom
	Relative Dosimetry	4	3D water phantom
PET CT	Air Calibration of CT	47	-
	Image Quality of CT	47	CAT phantom
	PET QC	158	^{22}Na source

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

Name of the participant	Title of the event	Organizer	Date	Place
M. Parvej, A. Rahim, M. J. Hosen, A. Hasnat, S. Suntana, R. Alam, Dr. J. Hosen, Dr. F. T. Zohra, M. K. Islam and S. Alim	25th International Conference on Physics in Medicine (ICPM)-2022	BMPA and BAEC	26-27 May 2022	AECD

3. Service Rendered and Revenue Income

Name of service provided		Number/quantity of sample/patient/service	Revenue income
PET Scan		443	1,11,70,000/-
CT-Simulation		178	1,24,600/-
Manual Plan		3	600/-
Patient Review		180	36,000/-
USG		5	1,800/-
3D CRT	Plan	175	9,04,600/-
	Fraction	3473	
Total			1,22,37,600/-

BEACH SAND MINERALS EXPLOITATION CENTRE (BSMEC), COX'S BAZAR

Objective/Introduction

- Geological exploration for economic placer minerals in the coastal and fluvial depositional environment of Bangladesh
- Routine laboratory and plant processing of placer sands; processing and separation of economic minerals like magnetite, ilmenite, zircon, garnet, rutile, silica from bulk sand
- Comparative study on the occurrence, distribution, mineral composition and characteristics of heavy and radioactive minerals from coastal and fluvial environment of Bangladesh
- Determining radionuclides and trace elements in the sediments and seawater of southeast coast
- Study on marine and coastal environmental radioactivity
- Laboratory beneficiation of radioactive mineral (i.e. Monazite) and quantification of radioactivity
- Providing research support and industrial training to academic and professional organizations

Activities

1. Research and Development Work(s)

1.1 Economic Minerals Exploration in Fluvial Depositional Area of Bangladesh

M. M. Karim and M. F.Hossain

In search of heavy and economic minerals, a base line geological survey has conducted on sand bars and bank of Teesta river adjoining Rangpur district. Total 35 (thirty five) raw sand samples of 2 kg each were collected from surface to one meter depth. Objective of the study to separate heavy and light minerals from the bulk sand therefore identify valuable minerals. Samples are being processed in laboratory for heavy liquid separation to ready for microscopic analysis.

1.2 Assessment of Heavy Minerals Deposition from Recent Deposits of Sand Bars and Bank of Teesta River

M. M. Karim and M. F. Hossain

The Teesta river brings sediments from Himalayan mountain range, so sediments are potential for heavy and economic minerals. Naturally heavy minerals accumulated in the sand bars and the bank of the river. Total 35 (thirty five) raw sand samples of 2 kg each were collected from surface to one meter depth. Samples were going through sun and air dry, unwanted and organic part removal and clay separation to ready for heavy liquid separation. Bromoform ($CHBr_3$) whose specific gravity is 2.88 were used to separate heavy minerals from light portion.An average heavy mineral percentage from heavy liquid separation is 6.5% where highest is 9.22% and lowest is 1.71%. Now samples are ready for microscope study.

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

Name of the participant	Title of the event	Organizer	Date	Place
M. F. Hossain	Carrier festival and research fair.	Faculty of Earth and Environmental Science, DU	17 Apr. 2022	TSC, DU

3. Repair, Maintenance and Renovation Works

- Rebuilding the boundary wall of the office to secure entire campus and to enhance esthetic view.
- Repair broken part of wall and roof of few rooms of the office building and repair cleavage of the roof-top of office building.

4. Service Rendered and Revenue Income

Rutile sale	210 kg	Tk. 7,350/-
Ilmenite sale	23 ton	2,30,000/-
	Total	2,37,350/-

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 environmental issues
- Expand cooperation with other scientific organizations, universities, private and public sectors through mutual exchange of educational programmes, 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 Ionizing Radiation Protection Efficiency of Common Mortar and Concrete Used for Infrastructure Construction in Bangladesh

A K M. S. I. Bhuian, S. Khatun, M. Debnath, N. S. Resma and S. Hossain

Description: Although ionizing radiations are widely used in various fields, the use of suitable shielding materials may help to control unwanted exposures, hence ensuring the benefits over risks. This paper aims to study the radiation shielding properties of common mortar and concrete used in Bangladeshi dwellings. Three most commonly used field concrete (cement : sand : stone = 1 : 1.25 : 2.5, 1 : 1.5 : 3 and 1 : 2 : 4) and mortar mix (cement: sand = 1 : 3, 1 : 4, 1 : 5) are tailor made for this purpose. Moreover, some other samples were prepared by partial replacement of the cement in the media with ladle slag. The transmission characteristics of 662 keV, 1173 keV and 1332 keV gamma-rays through the samples were measured using a p-type, coaxial HPGe gamma-ray detector. The well-defined radiation shielding parameters are evaluated from the experimental results. Furthermore, the mechanical properties of concrete and mortar samples are determined to verify the radiation shielding properties. It is found that concrete with field mix ratio 1: 1.5: 3 offers better shielding at low energy while 1:1.25: 2.5 composition is more effective in higher energy. Similarly, 1: 3 mortars are more effective for low energy and 1: 5 mortars provide better results for high energy radiation. Inclusion of ladle furnace slag slightly reduced the radiation shielding capacity of both mortar and concrete. Overall, conventional mortar and concrete used in infrastructure construction in Bangladesh show satisfactory results in shielding of gamma-rays in the energy range of 661 - 1332keV.

1.2 Spatial Distribution of Radiological Parameters from NORMs Measurement of Bangladesh using GIS Mapping Technique

A. K. M. S. I. Bhuian, N. S. Resma, M. Debnath and S. Hossain

Description: This study deals with the variation of radiological parameters due to naturally occurring radioactive materials (NORMs) and the corresponding radiological predictive mapping along whole Bangladesh. Natural radioactivity emanates from extraterrestrial sources as well as from NORMs due to 238U, 232Th and their daughters which subsist in the earth crust and varies with different geological formation of various rocks. It's important to have a background and baseline data of concentration of NORMs for the future use and safety from the radiation protection point of view. Keep that in mind, many researchers are measuring the environmental samples from all over the Bangladesh since few decades. But because of lacking of organized data or systematic sampling technique or accumulated data points, researchers were measuring the samples from locations of insignificant distance or locations. To avoid that redundancy in measurement from same sampling points for environmental NORM concentrations, we accumulated all the measured data points of Bangladesh from secondary data sources since 1990. Among all those measurements since 1990, about 58% of the study has been published in peer reviewed journals and about 42% studies remain unpublished due to error during measurements. To gather all data and respective position of measurement we divided the whole country into 2094 grids of 5′ ×5′ area which is about 25 square miles by using a geographic information system (GIS). After superposing the measured locations into it, we found that some of the locations (grid) have been chosen many times (max 13) and maximum regions have not been measured yet. So, there are a lot of blank regions (grids) which are needed to consider for future researches.

In this study we focus on the appraisal of absorbed dose rate due to NORM from 238U and 232Th series, 40K, 137Cs and the corresponding GIS predictive mapping for the secondary data collected from previously done, a total of ninety-five (95) research works in Bangladesh. With GIS, all the collected secondary data was accumulated as a whole, but there were a lot of locations from where no previous studies had done. So, Kriging interpolation method was used to interpolate the scattered data for absorbed dose rate and NORM concentrations by converting measured points into continuous surfaces Using GIS, radiological prediction maps for activity concentrations of 238U, 232Th, 40K, and absorbed dose rate were composed by kriging interpolation method. The resulting GIS maps were showing the variation of absorbed dose and activity concentration of NORMs. It is also found that the concentrations of 238U, 232Th, and 40K were range from 7.9-150.9 Bq/kg, 7.75-258.1 Bq/kg, and 198.0-1249.5 Bq/kg, respectively. Also absorbed dose rate ranges from 12.7-221.6 nGy/h.

At the same time, measurements of NORMs concentration of soil samples from 56 locations (grids) of Cumilla and Chandpur district of Chittagong division has been done in this study. The measured concentrations for 226Ra were in the range of 43.0±8.6 to 17±3.2 with an average value of 27.3±5.4. The measured concentration for 232Th was in the range of 72.0±8.6 to 28.0±3.2 with an average value of 46.1±7.9. The measured concentrations for 40K were in the range of 550.0±99.0 to 210.7±37.8 with an average value of 362.5±48.1 The absorbed dose rate was found in the range of 33.98 nGy/h to 83.41 nGy/h with an average of 55.57 nGy/h, which is lower than the world average value (137). The calculated values of annual effective dose rates found to be ranged from 0.042 mSv/y to 0.102 mSv/y with an average of 0.068 mSv/y. The radium equivalent activity in the soil samples was found in the range of 74.21 Bq/kg to 181.59 Bq/kg with an average of 121.12 Bq/kg which is higher than the world average value. The calculated values of representative level index found to be ranged from 0.54 Bq/kg to 1.33 Bq/kg with an average of 0.88 Bq/kg. The interpolated map for these regions are also made for different radiological parameters in this study.

This study is the first large-scale trial of radiological mapping in Bangladesh. The resulting GIS prediction maps and distribution study of radionuclides could be used to understand the variation and cause of variation of activity concentrations and corresponding absorbed dose rate in this country

1.3 Radioactivity Measurements and Analyses of Soil and Sediment Samples Taken from Chittagong City and Port Area on the Northern Shore of the Karnaphuli River

A. K. M. S. I. Bhuian, S. Khatun, N. S. Resma, M. Debnath and S. Hossain

Description: The activity concentrations of naturally occurring radioactive elements 226Ra. 232Th and 40K

in the soil and sediment samples (total of 78 samples) collected from different locations on the northern shore of the Karnaphuli River, Chittagong, Bangladesh for 13 months (Sept. 2020- Sept. 2021) were determined by using High Purity Germanium (HPGe) gamma-ray spectrometry system. The average activity concentrations of 226Ra, 232Th, and 40K were found to be within the range of 15.17 ± 4.06 to 26.34 ± 4.59 Bq/kg, 33.67 ± 6.59 to 44.51 ± 7.97 Bq/kg and 440 ± 48.40 to 669.17 ± 95.44 Bq/kg respectively. However, no artificial radionuclide such as 137Cs was found in the study area. From these values, monthly absorbed dose rates, radium equivalent activity, annual effective dose rates, the radiation hazard indices, gamma index, excess lifetime cancer risk and annual gonadal dose equivalent for these samples were evaluated. The absorbed dose rates for the period were found within the range of 41.14 ± 5.43 to 67.40 ± 5.21 nGy/hr. Statistical analysis was performed between the gamma dose rate and meteorological parameters, namely, atmospheric pressure, relative humidity, and temperature. No significant seasonal variations were observed. The correlation between the measured monthly gamma dose rates and meteorological parameters indicates that meteorological parameters do not significantly influence the outdoor gamma dose rates. The radium equivalent activity, annual effective dose rates, the external and internal hazard index, gamma index, excess lifetime cancer risk and annual gonadal dose equivalent were found in the range of 98.19 to 137.33 Bq/kg, 0.051 to 0.083 mSv/y, 0.276 to 0.384, 0.325 to 0.456, 0.294 to 0.446, 0.185 to 0.185 and 0.141 to 0.341 mSv/y respectively. Observed values were compared with those from different regions within Bangladesh and other countries.

1.4 Biosorption of Toxic Heavy Metal Lead Ion by Raw Tea Leave in the Chittagong Zone

S. Hossain, N. Deb, C. K. Mahmud and N. Khatun

Description: Raw old and young tea leaves from tea gardens of winter season which are of no use in tea production were assessed for their potential to remove lead (II) from aqueous solutions because of its availability in Bangladesh and its low cost. Six types of tea leaves samples of different ages (young and old leaves) were taken from three tea estate of Chittagong zone which are respectively Rangapani, Banshkhali and Oodaleah. Batch adsorption experiments made at temperatures between 30º C to 60º C and lead nitrate (Pb $(NO_3)_2$) concentrations between 6624 mg/L to 33120 mg/L. The heavy metal solutions with different concentrations and bio-sorbent materials of different weights were put into orbital shaker at an optimum temperature for different time periods. The solutions were filtered and the concentrations of resulting filtrate were determined using AAS (Atomic Absorption Spectrometer). These sample of tea leaves were used to observe the Pb(II) uptake from the aqueous solution of (Pb $(NO_3)_2$). The result showed that the removal efficiency is higher than 97% can easily be achieved. The final concentration is obtained between 0.873 mg/l to 43.25 mg/L. This process was carried out as a function of contact time, initial metal ion concentration and biosorbent dosage. This biosorbent showed good affinity for Pb (II), and the maximum uptake was 1655.855 mg/g. These research could help to ascend from initial exploratory studies to a more advanced general conclusion that raw tea leaves (Camellia sinensis) has a great potential for Pb(II) uptake as such a low cost adsorbent for the effective removal of Pb(II) from aqueous solution. Thus tea leaves can be an important aspect to save the environment by reducing the amount of heavy metals.

1.5 Estimation of Potential Toxic Heavy Metal in Rice of Chittagong District

S. Hossain, N. Deb, C. K. Mahmud and N. Khatun

Description:Heavy metals are toxic in nature, and their contamination in foodstuff is a matter of concern for human health. Dietary exposure to heavy metals is a matter of concern for human health risk through the consumption of rice for which it is urgent to determine the metal nutritional status as well toxicity of rice. The present study was conducted to assess the concentrations of chromium, copper, cadmium, lead, iron, zinc and manganese in rice and their possible human health risks in Chittagong district, Bangladesh. Metals were measured by atomic absorption spectroscopy (AAS) after digestion. The metals detected in rice samples ranged from 9.759 to 0.393 mg/kg of Fe, 0.571 to 0.127 mg/kg of Cu, 5.20 to 0.325 mg/kg of Zn, 2.615 to 0.895 mg/kg of Mn and 0.018 mg/kg of Cr.Iron, manganese, zinc, chromium, and copper concentrations were ranked in this order: Fe>Mn>Zn>Cu>Cr. Cd and Pb are below the detection limit, while the mean amounts of Cr, Cu, Fe, Zn, and Mn in rice were 0.018, 0.2197, 4.4824, 1.221, and 1.585 mg/kg, respectively. The FAO/WHO standard values for food samples are not exceeded by the mean value of all the heavy metals. Overall, the current investigation shows that the trace element levels (with the exception of Fe) were often below allowable limits. However, Fe was found to be greater in some samples. Therefore, it is clear that the metal concentration in the rice from the Chittagong district is well below the safe intake level.

1.6 Assessment of Heavy Metals Concentration in Waste Liquids Discharged by the Factories at Nasirabad Industrial Area, Chattogram, Bangladesh

S. Hossain, N. Deb, C. K. Mahmud, and N. Khatun

Description:The waste products in liquid form discharged by the different types of industries likegarments, food, steel, plastic & packaging, metal, oil, tissue paper, printing,petrochemical, aluminium & soap at Nasirabad Industrial Area, Chattogram,Bangladesh were analyzed for metallic elements Fe, Cu, Mn, Pd and Zn. Theconcentrations of these heavy metals were obtained by atomic absorptionspectrophotometer (AAS) analysis with flame atomizer. The investigation showedthat the waste liquids of all types of selected industries contained all the investigatedmetallic elements except Pd. The highest concentrations of Fe (214.55 ppm) and Cu(4.4 ppm) were found in the waste liquids of food & steel factories and the highestconcentrations of the elements Mn & Zn (Mn-67.87 ppm, Zn-17.85 ppm) werefound in the waste liquids of plastic & lp gas factories. Moreover, the maximumvalues of the Fe, Cu, Mn and Zn were found higher than the permissible limit ofwater, plant and soil. Pb was not found in any industries. The overall investigationshowed that the waste liquids may be considered harmful for cultivated area but not fordrinking water. However, the discharge of this wastewater into the open field or incanal or in drain may play a vital role to increase the heavy metals in theenvironment and in changing the ecosystem of the cultivated and river area.

2. Manpower Development and Training programme

Title of the event	Date	Place	No. of participants
Seminar on operation & maintenance of Ion Chromatograph	10 Nov. 2021	AECC, BAEC	20

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

Name of the participants	Title of the event	Organizer	Date	Place
Dr. S. Hossain	Feasibility Study for Development Project	BIM	20-21 Mar. 2022	BIM, Dhaka
N. Deb	এসডিজি বাস্তবায়ন সংক্রান্ত সমসাময়িক বিষয়ে লার্নিং সেশন/ কমশালা	SID, BAEC	14 Feb. 2022	Online
C. K. Mahmud	Training on Atomic Absorption Spectrophotometer (AAS) Method Development for the determination of Copper for the investigation of Wilson Disease.	AECD	12-15 Sept. 2021	AECD
N. S. Resma	28th BAB assessor training course on ISO/IEC 17025:2017	Bangladesh Accreditation Board	26-30 Sept. 2021	Seminar Hall, Ministry of Industry
R. Roy	Training on APAMS Software	SID, BAEC	30 Dec. 2021	Online
	এসডিজি বাস্তবায়ন সংক্রান্ত সমসাময়িক বিষয়ে লার্নিং সেশন/কমশালা	SID, BAEC	14 Feb. 2022	Online
	তথ্য অধিকার এবং অভিযোগ প্রতিকার ব্যবস্থা ও জিআরএস সফটওয়্যার	SID, BAEC.	19 Apr. 2022	Online
F. Begum	তথ্য অধিকার এবং অভিযোগ প্রতিকার ব্যবস্থা ও জিআরএস সফটওয়্যার	SID, BAEC.	19 Apr. 2022	Online

4. Stakeholder Meeting

One Stakeholder meeting and one E-learning session were arranged at the Atomic Energy Centre, Chattogram on 08th Nov. 2021 and 03rd Jan.2022.

5. Collaboration Work

5.1 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.

5.2 IAEA/RCA Project - RAS7028

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.

5.3 IAEA/RCA Project– RAS7038: Monitoring the Marine Environment for Enhanced Understanding of the Abundance and Impact of Marine Plastic Pollution. Objective: To enhance understanding of the abundance and impact of marine plastic pollution in the Asia and Pacific Region.

7. Service Rendered and Revenue Income

Name of service provided	No. of sample	Revenue income
Radioactivity testing of imported food and allied materials	19054	245,948,477 /-
Radioactivity testing of miscellaneous food-stuffs	32	156590/-
Total		245439991/-

RADIOACTIVITY 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
- 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. Training Programme/Workshop/Seminar/Symposium/Conference/Meeting Attended

Name of the participants	Title of the event	Organizer	Date	Place
Mithun Chandra Bhakto	FTC on Nuclear and Radiological Emergency Preparedness	BAEC	21 Nov.-02 Dec.2021	TI, AERE,

2. Service Rendered and Revenue Income

Name of service	No. of sample	Income
Measurement of radioactivity in food	84	1653393/-

II. BIO-SCIENCES

INSTITUTE OF FOOD AND RADIATION BIOLOGY (IFRB), AERE, SAVAR

Agrochemical and Environmental Research Unit, IFRB

Objective/Introduction

- To know the present status of residues of pesticides, heavy metals and trace elements in food and environment
- To generate and provide pesticide residue data for fixing National Acceptable Daily Intake (ADI) and Maximum Residue Limit (MRL) of Bangladesh
- To promote safe and effective use of pesticides for safe guarding human health and environment

Activities

1. Research and Development Work(s)

1.1 Assessment of Toxic Heavy Metals and Trace Elements in Poultry Feeds, Consumer Chickens and Eggs in Bangladesh

M. A. Z. Chowdhury, M. A. Rahman, Z. Fardous and M. Nesha

The distribution and deposition of heavy metals and trace elements including Mn, Fe, Cu, Zn, Cd, Cr, and Pb in different tissues (skin, brain, liver, meat, and bone) of broiler and layer chickens, their feeds, litter, and eggs were analyzed using atomic absorption spectrophotometer (AAS) after nitric/perchloric acid digestion. The samples for this study were taken from four poultry industries located at Sreepur upazila of Gazipur district of Bangladesh. The observed levels of heavy metals and trace element contents in different studied samples were to be in the range of 0.143±0.001 to 7.324±0.004 mg/kg for Mn, below the detection limit (BDL) to 324.43±0.003 mg/kg for Fe, 0.451±0.002 to 4.329±0.005 mg/kg for Cu, 0.014±0.001 to 7.413±0.003 mg/kg for Zn, 0.082±0.002 to 7.806±0.002 mg/kg for Cr, 0.112±0.002 to 1.581±0.002 mg/kg for Cd, and BDL to 34.775±0.004 mg/kg for Pb. Although some elements were found at a lower concentration in feed samples, they were found at a higher level in various parts of the examined chickens, eggs, and litter which may be resulted from other sources such as drinking water, soil, and the surrounding environment of the poultry industries. The brain contained a maximum amount of Cd, Cr, and Pb in comparison to other studied tissues of poultry. Most of the chicken body parts showed an excess level of Cr than the recommended guidelines. The Cu and Zn contents were usual in studied egg samples, whereas Mn, Fe, Cd, Cr, and Pb were found higher than their tolerance limits which are highly alarming for public health and demand regular governance and monitoring.

1.2 Alterations of Serum Trace Elements and Other Biochemical Parameters are Correlated with The Pathogenesis of Systemic Lupus Erythematosus: A Preliminary Study on Bangladeshi Population

Z. Fardous, M. A. Rahman, M. Nesha and M. A. Z. Chowdhury

This analysis demonstrated that patients with systemic lupus erythematosus (SLE) possessed a significant ($p < 0.001$) higher level of MDA and lower level of vitamin C compared to control subjects. Pearson's correlation analysis found negative correlation between the serum level of MDA and vitamin C ($r= -0.023$, $p = 0.887$) for patients while control group also possessed similar result ($r= -0.157$, $p = 0.453$). The current findings have also revealed that serum level of Zn and Cu in SLE patients was significantly ($p < 0.05$) lowered to that of the control group, while serum level of Mn also showed a similar scenario. During Pearson's correlation analysis a significantly ($p < 0.05$) negative correlation was found between Zn and Mn ($r= -0.410$, $p = 0.042$) in patients' group. Conclusion: Although our study was limited to a small sample size and confined to a particular area of the country, the study results support a significant role of antioxidants, CRP, and trace elements in the generation of SLE and, therefore, recommend a large spectrum study of the associations between SLE and these biochemical parameters.

1.3 Assessment of Heavy Metal Contamination in The Surficial Sediments from The Lower Meghna River estuary, Noakhali Coast, Bangladesh

M. Nesha, Z. Fardous, M. A. Z.Chowdhury and M. A.Rahman

Sediment samples were collected from ten selected sites of the lower Meghna River estuary, and six heavy

metals were analyzed with Atomic Absorption Spectrophotometry (AAS) to assess the contamination level and the metals' association with sediment grain size. The current results revealed that the mean concentrations of the studied metals were ranked in descending order of iron (Fe) (1.29 x 10^3 mg/kg)>zinc (Zn) (42.41 mg/kg)>lead (Pb) (12.48 mg/kg)>chromium (Cr) (10.59 mg/kg)>copper (Cu) (6.22 mg/kg)>cadmium (Cd) (0.28 mg/kg). The geo-accumulation, contamination, and pollution load indexes suggested that the lower Meghna river estuary was not contaminated by Fe, Zn, Pb, Cr, and Cu. The mean size of the sediment ranged from 28.92 to 126.2 mm, and the Pearson correlation coefficient showed a significant association between Fe and Pb (coefficient of determination, r^2 ¼ 0.836; $p < 0.05$), and no significant correlation was found between individual metals and grain size, indicating no or low influence on the metals distribution.

2. Manpower Development and Training Programme

Title	Date	Place	No. of participant
In house Training course on Assessment of Trace Elements in Serum in Rheumatoid Arthritis's Patients	22 Oct. 2021	AERD , AERE	6
In house Training course on Analysis of DDT residue along with its metabolites in dry fishes from some selected markets of Dhaka	25 Nov. 2021	AERD , AERE	6
In house Training course on Accumulation of Heavy Metals in Water and Sediments of Different Lakes of Matlab Uttar Upazila of Chandpur District, Bangladesh	28 Dec. 2021	AERD , AERE	6

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 safety (food fraud, adulteration, origin authentication, species identification etc.) and quality (nutritional, functional and microbiological quality) through conventional and nuclear technology. Research works of FSQAD also focus on development of convenience food and food additives from different kinds of food and food derivatives.

Activities

1. Research and Development Work(s)

1.1 Combination Impacts of Gamma Radiation and Low Temperature on The Toxin-Producing *Bacillus cereus* Isolated From Fried and Steam Rice

M. K. Munshi, F. A. Sukhi, R. Huque, A. Hossain, S. Mahbub, S. A. Hoque, T. Hossain, M. S. I. Khan and M. F. Hossain

Thirty randomly collected steam and fried rice sample from Dhaka City were investigated for toxin-producing *Bacillus cereus* to observe the antibiotic sensitivity and survival ability of the toxic strain in combination treatment of gamma radiation and low temperature. Twenty-nine strains of *Bacillus* spp. were isolated and seven strains were confirmed as pathogenic B. cereus. A known toxic strain KTCC 11,204 and seven pathogenic strains were subjected to cytotoxic effect analysis using Vero cell through protein estimation. KTCC 11,204 and one toxic *B. cereus* strain was treated by gamma radiation at 4, 6 and 8 kGy dose and 4°C temperature for three consecutive days. At third day of storage, Toxic *B. cereus* count was significantly low and totally eliminated at 8 kGy dose during all storage period. The toxic *B. cereus* was further tested against 10 antibiotics and found highly sensitive to imipenem, penicillin, amoxycillin, ampicillin, and chloramphenicol.

1.2 Gamma Radiation Processing of Honey of Mustard, Black Seed and Lychee Flower: Measurement of Antioxidant, Antimicrobial and Fourier Transform Infrared (FT-IR) Spectra

M. A. Khatun, M. Razzak, M. A. Hossain, A. Hossain, M. Islam, M. Shahjalal, R. A. Khan and R. Huque

Gamma radiation is used in many countries due to combating microorganisms in food. Honey is considered as a reservoir of microbes; hence the purpose of this study was to sterilize honey by applying radiation and evaluate the antioxidant and antibacterial potential of honey after radiation processing. Three types of Bangladeshi origin unifloral honey: mustard (Brassica juncea), Black seed (Nigella sativa) and Lychee (Litchi chinensis) were selected. The raw (unirradiated) black seed honey possessed the highest content of total phenolic and vitamin C contents, accordingly showed significantly higher ($p<0.01$) free radical scavenging activity compared to others. Radiation processing was found to achieve microbial destruction in honey completely. Significant enhancement of phenolic compound as well as antioxidant activity was observed in the irradiated honey. Moreover, antibacterial potential of all the honeys has been conserved after radiation processing. The statistics showed significant positive correlation among phenolic ($R2=0.95$) and vitamin C ($R2=0.72$) content in relation to free radical scavenging activity of honey. FTIR spectroscopy showed no distinct changes in the vibrational intensity of functional groups (-OH, C=H, C=O) indicating nonsignificant changes in the chemistry of the sugar components of honey. Thus, radiation processing of honey could be a useful technique to preserve honey free from microbes and improved beneficial for health compared to unirradiated honey.

1.3 Potentiality of Ginger Extract as Natural Preservative for Raw Tilapia Fish (*Oreochromis mossambicus*) During Storage at Refrigerated Temperature

M. Islam, A. Hossain, M. A. Rahman, M. A. Khatun, M. Shahjalal, M. A. Hossain, R. Huque and M. K. Munshi

Description: The effectiveness of ginger extract for preserving fresh tilapia fish (O. mossambicus) at refrigerated temperature ($4 \pm 1°C$) was studied. The samples were treated with 10, 15, and 20% of ginger extract for 0, 4, 8, 12, and 16 days of storage. The sensory quality, biochemical components such as thiobarbituric acid reactive substances (TBARS) and tyrosine value (TV) and microbial growth were measured to observe the impact of treatment at refrigerated temperature. It was found that ginger extract solution at 15% retains the sensory feature, resists microbial growth, and significantly ($p< .05$) decreased the protein and lipid degradation rate of tilapia fish up to 12 days compared to untreated fish. The sensory evaluation stated a negative significant correlation with TBARS, TV, and count of total viable bacteria, coliform, Salmonella, Shigella, and Staphylococcus. Thus, dipping of tilapia fish into 15% ginger extract found as more effective for extending shelf-life up to 12 days

2. Manpower Development and Training Programme

Title of the event	Date	Place	No. of participant
Safety Assessment of Foods Derived from Genetically Engineered Plants	Jun. 12, 2022,	Bangladesh Food Safety Authority	2
The virtual training course on Near Infrared spectroscopy for Food Authenticity	28 Jun. – 4 Jul. 2021	IAEA	6

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

Name of the participant	Title of the event	Organizer	Date	Place
Dr. R. Huque and Dr. M. K. Munshi	Biotechnology Outreach Conference	The Agriculture & Food Systems Institute in collaboration with Biotech Consortium India Limited	14-15 Jun. 2022	Dhaka, Bangladesh

4. Collaboration Work(s)

4.1 IAEA RCA project, Code: RAS 6103

Applying Stable Isotope Techniques to Assess Protein Quality of Sustainable Food Sources for the Improvement of Maternal and Child Nutrition

Plant protein is a natural and major protein sources in the Asia-Pacific region. Daily per capita intake of plant

protein has been reported to be 50-70% in Myanmar, Kuwait, Thailand, Vietnam, Pakistan and Indonesia. Globally, the increased preference for plant-based protein food sources includes the nutritive compositions (lower calories and fat, containing higher fiber and essential nutrients) compared to animal food sources. Production of plant protein also offers an environmental –friendly and sustainable solution due to the lower energy consumption, emissions, land usage and water consumption. This regional project will provide data on protein quality from plant-based or sustainable protein food sources in the Asia-Pacific region aiming at improving maternal and child nutrition and health.

5. Service Rendered and Revenue Income

No. of service given organization	Nature of sample	Number of sample	Revenue income
Bengal Biscuit Limited	fat , carbohydrate, sugar and protein	Duplex cream biscuit	5500/-
Arla Foods Bangladesh Limited	fat and moisture	Dano powder milk	1300/-
NPI university of Bangladesh	Protein	Aloevera Drinks and Aloevera with moringa leaves Drinks	2000/-
Total			8800/-

Gamma Source Division, IFRB

Objective/Introduction

Gamma Source Division (GSD) of Institute of Food and Radiation Biology (IFRB) has been rendering irradiation services since 1979 to different institutes/organizations and private companies using Co^{60} panoramic gamma irradiator. GSD is the pioneer irradiation service provider in Bangladesh. The main objectives of this division are to provide irradiation services in research and commercial sectors and to develop and utilize gamma irradiation technology for better quality products. GSD has provided irradiation services for research purpose to 15 different government (including institutes of BAEC) and private organizations at free of cost during Jul., 2021 to Jun., 2022. During this time period, GSD has rendered irradiation services to commercial products of 10 food industries and 43 medical and pharmaceutical companies of Bangladesh and earned 27,11,775/- revenue for the country. The radioactivity of the source was 36.53 kCi on 1st Jul. 2021 and 32.33 kCi on 30th Jun. 2022.

Activities

1. Research and Development Work(s)

GSD has provided irradiation services for research purpose to various divisions/institutes of Bangladesh Atomic Energy Commission (BAEC), Bangladesh Agriculture Research Institute (BARI), Rajshahi University (RU), Dhaka University (DU), Khulna University (KU), UniMed UniHealth Pharmaceutical Ltd., Reneta Pharmaceutical Ltd., Al-Madina Pharmaceutical Ltd., Sharif Pharmaceutical Ltd., IBN Sina Pharmaceutical Ltd., Mawlana Bhasani Science & Technology University etc at free of cost during this time period. GSD provides irradiation service for research purpose to 159 food samples (rice seed, rice spike, wheat, mango, biscuit, java apple jelly, raw mango jelly, java apple, banana, potato, sweet potato, mascale seeds etc.) and 3,565 medical and pharmaceutical samples (Bone graft, bone chips, amnion graft, skull bone, scaffold, amniotic membrane, hydrogel, fexofenadine hydrochloride USP, chitosan, gelatin film etc.).

2. Service Activities

GSD rendered commercial sterilization services to 53 different pharmaceuticals, medical, food processing and manufacturing, supplier companies during this service time period. The names pharmaceutical and medical companies are: The ACME laboratories Ltd, General Pharma Ltd, Polycon Ltd, Aristopharma Ltd., IBN Sina Pharma Ltd., Apex Pharma Ltd., Popular Pharma Ltd., Square Pharmaceuticals Ltd., Ziska Pharmaceuticals Ltd., Team Pharma Ltd., Healthcare Pharmaceutical Ltd., Kumudini Pharmaceutical Ltd., Incepta Pharmaceutical Ltd, Ethical Drugs Ltd., PCC Corporation, Technokit Corporation, GB Medical Ltd., UniMed UniHealth Pharmaceutical Ltd. Etc and the name of food processing & manufacturing companies: Pran Foods

Ltd., Aman Enterprise, ZAP Natural Product Ltd., Rawson Corporation, Ryan Trade International, Bizmate Trading International etc. GSD earned 27,11,775/- revenue through rendering irradiation to 14.519 ton food products and 4,455 cft medical and pharmaceutical products including 7,800 pcs shell dressing.

3. Manpower Development and Training Programme

Title	Date	Place	No. of participant
Seminar on Biological Effects of Gamma Irradiation and Activities of Gamma Source Division of IFRB	15.06.2022	IFRB Seminar Room	30

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

Name of the participant	Title of the event	Organizer	Date	Place
Dr. M. Khan	7th NTC-HRDB meeting	Ministry of Science and Technology (MoST)	1 Sept. 2021	Ministry of Science and Technology (MoST), Dhaka, Bangladesh
	Second RCM on 'Assessment of Simultaneous Application of SIT and MAT to Enhance Bactrocera Fruit Fly Management'	Joint FAO/IAEA Research Coordinated Meeting (CRP No. 23135/R2)	28 Jun. -2 Jul. 2021	Vienna, Austria (Virtual)
	webinar: Starting the Implementation Phase of the TC Programme Cycle 2022-2023: Best Practices of the Process	IAEA	8 Dec. 2021	Vienna (Virtual)
	Virtual Bilateral Consultations on the TC Programme in Asia and the Pacific on the Occasion of the 65th Regular Session of the IAEA General Conference	IAEA	20 Sept. 2021	Vienna (Virtual)
	1st RCM on 'Improving the Quality Management Practices in Radiation Processing Facilities for Better Performance and Applications' Malaysia	Joint FAO/IAEA Regional TC Project (RCA) (RAS/1028)	28- 31 Mar. 2022	Virtual
	2nd meeting of Agricultural and Food Products Divisional Committee (AFDC), BSTI	Ministry of Industry	24 May 2022	BSTI
	Workshop on 'National Good Practice and Good Governance'	Bangladesh Institute of Management	22 Jan. 2022	Virtual
	1st RCM on 'Enhancing the Capacity and the Utilization of the Sterile Insect Technique for Aedes Mosquito Control'	Joint FAO/IAEA Non RCA Project (RAS/5095)	20 Apr. 2022	Vienna, Austria (Virtual)
Dr. M. F. Mortuza	Instructor training course 2021 on Environmental Radioactivity Monitoring	JAEA	30 Aug. - 16 Sept. 2021	Online
	EVT2004044, 1st Research Coordination Meeting of the New CRP " Phytosanitary Treatment of Food Commodities and Promotion of Trade (CRP D61026)	IAEA	22-23, 28, 30 Mar. 2022	Online

Name of the participant	Title of the event	Organizer	Date	Place
	Seminar on Radiation Safety of Import-Export Control and Uses of Radioactive materials and Radiation Generating Equipment in Bangladesh	Bangladesh Atomic Energy Regulatory Authority (BAERA)	6 Jun. 2022	BAERA conference room
	Food Irradiation- Technology, Applications and Good Practices	IAEA	11 Feb. 2022	IAEA's Learning Management system (Online)
	An Introduction to Safeguard	IAEA	18 Feb. 2022	IAEA's Learning Management system (Online)
	Introduction to Nuclear Forensics	IAEA	21 Feb. 2022	IAEA's Learning Management system (Online)
A. Nahar	KOICA-IAEA Fundamentals of Radioisotopes and Radiation Technology: Principle of Accelerator and their Application	KOICA-IAEA	27 Sept. and 8 Oct. 2021	Online
	Food Irradiation- Technology, Applications and Good Practices	IAEA	6 Apr. 2022	IAEA's Learning Management system (Online)
M. A. Hoque	ই-গভর্ন্যান্স ও নাগরিক সেবায় উদ্ভাবন	Innovation Team BAEC	26 Jun. 2022	BAEC Head Quarter

3. Paper Reviewed

- M. Khan, reviewed manuscript number: ECONENT-2021-0484, entitled "The bulking agent modifies the protein: carbohydrate ratio and bioconversion of the larval diet, affecting its cost-effectiveness by changing the nutrition and life history traits of *Anastrepha ludens* (Diptera: Tephritidae)" for the Journal of Economic Entomology.
- M. Khan, reviewed manuscript number: INS-2021-06-308, entitled "Gut fungal community and its probiotic effect on *Bactrocera dorsalis*" for Journal of Insect Science.
- M. Khan, reviewed manuscript, entitled "Appraisal of growth inhibitory, biochemical and genotoxic effects of Allyl Isothiocyanate on an agricultural pest, Zeugodacus cucurbitae (Coquillett) (Diptera: Tephritidae)". Scientific Reports.

6. Collaboration Work(s)

- Project Title: Improving the Quality Management Practices in Radiation Processing Facilities for Better Performance and Applications (RCA); Project Code- IAEA Regional TC:RAS/1028. Dr. Mahfuza Khan is working as National Counter Part (CP) and Dr. Firoz Mortuza is as Alternate National Counter part of this project. Others divisional members are the national team members of this project.
- Project Title: Determination and validation of generic phytosanitary irradiation dose of insects pests (Order: Lepidoptera) of food commodities highlighting on the effects of irradiation dose-rates; Research Contract no. 25011 under CRP-D61026). Dr. Firoz Mortuza is the Chief Scientific investigator and Arifatun Nahar is Additional Chief Scientific Investigator of this project. Others divisional members are working as scientific workers in the project.

7. Secretariat Work

- M. Khan worked as 'Director', executed administrative responsibility, and Head of Gamma Source Division (GSD) (additional in charge), Institute of Food and Radiation Biology (IFRB), AERE, BAEC
- M. Khan worked as DPC Member- DPC-3: Bangladesh Atomic Energy Commission (BAEC)
- Mahfuza Khan worked as 'Seminar Coordinator', Institute of Food and Radiation Biology (IFRB), AERE, Savar
- M. Khan worked as member of Agricultural and Food Products Divisional Committee (AFDC), BSTI, Ministry of Industry

8. Service Rendered and Revenue Income

No. of organization	Nature of sample/service	Quantity of sample	Revenue income
5	Food Irradiation	159 pcs	Free
10	Medical and Pharmaceutical Products Irradiation	3,565 pcs	Free
10	Food Irradiation	14.519 Ton	5,02,375/-
43	Medical and Pharmaceutical Products Irradiation	4,455 cft	21,70,450/-
		7,800 pcs Shell dressing	38,950/-
Total			27,11,775/-

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 PCR-RFLP Based Molecular Identification of Ten economically Important Fruit Flies (Diptera: Tephritidae) of Bangladesh by using PCR-RFLP

A. Ghosh, N. Sultana, M. F. Hossain, M. A Hossain, M. A. Bari, M. Momen and K. Seheli

Proper identification of insect pests at species level is considered as the first step towards implementing successful control strategies against their dispersal. In this context, molecular techniques are best used to support morphological identification. PCR-RFLP is a rapid tool for differentiate tephritid fruit fly pests. In the present study, an initiative was taken to identify ten economically important dacine fruit flies using a PCR amplification technique to successfully establish RFLP patterns of the Internal Transcribed Spacer 1 (ITS1) region. The specific primer pair baITS1f/ baITS1r was used to amplify ~520-840 base pair long fragment of the ITS1 region. The amplified fragments were varied in size among species and able to differentiate at genus level from *Bactrocera* to *Zeugodacus.* But interspecies variations are not clearly distinguished by ITS1 banding profile alone. Due to the ambiguity in band size, they were then subjected to RFLP digestion with two restriction endonuclease enzymes (HhaI and Sau3aI). The restriction enzymes have different cutting sites and thus displayed different banding patterns among species. The outcome of this study will enhance early detection and easy monitoring of these pest species and quarantine at the port of entry.

Effect of Semio-Chemicals (Methyl eugenol) on the Mating Performance of *Bactrocera dorsalis* (Hendel) (Diptera: Tephritidae)

M. Khan, M. A. Bari, M. Momen, M. F. Hossain and A. Ghosh

The Oriental fruit fly, *Bactrocera dorsalis* (Hendel) is one of the destructive invasive pests world-wide. Males of *B. dorsalis* are strongly attracted to natural compounds known as semio-chemicals (methyl eugenol, ME).

Here we demonstrated two different delivery systems i.e., aromatherapy (exposure) and pharmacophagy (feeding) of ME as a pre-release supplement to enhance the mating success of male *B. dorsalis* under laboratory condition. Mating performance in terms of mating pairs, mating latency and mating duration of ME treated males with control males and virgin females were observed. Experimental results revealed that sexually mature *B. dorsalis* males treated with ME-aromatherapy achieved higher levels of mating success than control males. Feeding immature adult *B. dorsalis* did not accelerate sexual maturation and mating success than untreated males. The present findings indicated ME aromatherapy as a potential delivery system that enhances the mating success of male *B. dorsalis* and can increase the effectiveness of the Sterile Insect Technique (SIT) manifold.

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

Name of the participant	Title of the event	Organizer	Date	Place
A. Ghosh and M. F. Hossain	Virtual Workshop TC Meeting-RAS5082, (EVT1903355)	IAEA	6-10 Sept. 2021	Vienna
	Virtual Workshop TC Meeting-RAS5082, ((EVT2105346)	IAEA	12-19 Jan. 2022	Vienna
M. A. Bari	22nd National Conference & AGM 2020 on "Covid-19 challenges: Integrating Human Health, Zoonotic Diseases and Ecosystem Conservation"	Zoological Society of Bangladesh	29 Oct. 2021	Virtually
	2021 Asian Federation of Biotechnology (AFOB) Virtual Conference	AFOB	01-04 Nov. 2021	Virtually
M. A. Hossain	22nd International Biennial Conference & AGM	Zoological Society of Bangladesh	18 Mar. 2022	Department of Zoology, DU
	Virtual First Regional Coordination Meeting – RAS5097	IAEA	21-23 Jun. 2022	Vienna
Dr. K. Seheli	E-Nothi Training	ICS	28 -31 Mar. 2022	ICS, AERE
M. A. Hossain and M. A. Bari	11th Biennial Conference on 'Insect Pest Management for safe food and public health	Bangladesh Entomological Society	13 May 2022	BARC, Dhaka

4. Collaboration Work(s)

- IAEA Coordinated Research Programme CRP No. 23909/R0 (2020-2025) titled 'Optimization of ɤ-Irradiation Process for Mass Sterilization and the Quality Assurance of Sterile Aedes aegypti for Field Release Programme'
- FAO/IAEA Coordinated Research Programme CRP No. 23135/R1 (2019-2024) titled 'Assessment of Simultaneous Application of SIT and MAT to Enhance Management of the Melon Fly, *Zeugodacus cucurbitae* (Coq.) and the Oriental Fruit Fly, *Bactrocera dorsalis* (Hendel) in Bangladesh'
- FAO/IAEA Technical Cooperation Project IAEA TC BGD 5035**,** 2022-2025 (2022-2025) titled 'Validating the Sterile Insect Technique (SIT) as a Key Component of an Area-Wide Integrated Pest Management (AW-IPM) Programme against *Aedes aegypti* in Dhaka'
- IAEA RCA Project No. RAS/5097 (2022-2025) entitled "Strengthening and Harmonizing Surveillance and Suppression of Fruit Flies"

Microbiology and Industrial Irradiation Division, IFRB

Objective/Introduction

This division is one of the pioneer divisions of IFRB. The division deals with microorganisms closely associated with the health and welfare of human being. MIID is basically involved in doing research and development work on different aspects of Radiation Microbiology.

Activities

1. Research and Development Work(s)

1.1 Evaluation of Antibacterial Activity of Chitosan-Silver Nanocomposites (Ch-Si NCs) After γ-Irradiation

M. A. K. Sarker and M. K. Pramanik

Chitosan and its derivatives have a wide range of beneficial effects. It has antitumour effects against various types of human cancers, antibacterial effects against a variety of pathogenic bacteria, and has wound healing capabilities. However, chitosan and its derivatives have a major limitation as they are barely soluble to water and other organic solvents. The solubility and biocompatability of chitosan and its derivatives can be greatly increased by the exposure to gamma (γ) irradiation. It has also been shown that γ-irradiation can also increase the antimicrobial activity of chitosan. Recently we have reported that γ-irradiation can cause increased antibacterial activity of chitosan both in Gram-positive and Gram-negative bacteria. We have prepared chitosan-silver nanocomposites (Ch-Si NCs) and irradiated with γ-irradiation with different doses and evaluated their antibacterial activity against Gram-positive and Gram-negative bacteria. *Staphylococcus aureus* ATCC 6538 was used as Gram-positive bacterial strain, whereas, *Escherichia coli* ATCC 35150 was used as Gram-negative bacterial strain to assess the antibacterial activity of this nanocomposites. We used three different concentrations (0.5%, 1.0%, and 1.5% in acetic acid) of Ch-Si NCs and evaluated their antibacterial activities by exposure of 5.0 kGy and 10.0 kGy γ-irradiation. We found that 5.0 kGy γ-irradiation produced significantly bigger zone of inhibition at 0.5% and 1.0% of Ch-Si NCs whereas at 1.5% concentration the zone of inhibition was reduced after applying the γ-irradiation.

1.2 Determination of Calcium Content from Different Types of Egg Shells

M. ZahidHasan, M. S. A. Sarker and M. K. Pramanik

As an ideal protein source, eggs- especially chicken eggs have been consumed in majority of upper middle class people in Bangladesh. Along with the nutritionin eggs, eggshells also contain different nutritional and non-nutritional elements. With more than 90% of Calcium carbonate, eggshells can be a very good source of dietary calcium. 2 types of chicken eggs (white and brown) are consumed in Bangladesh. Every day, large proportion of eggshells is being wasted which may result into environmental pollution if not utilized further. With this background, a comparative study was undertaken to study the calcium content of these two types of eggshells. It was found that, white eggshells showed relatively higher percentage of $CaCO_3$ (95.73%) than brown eggshells (93.58%). Thus, with a suitable extraction method, these white eggshells can replace the supplemental calcium available in the market.

1.3 Screening of Probiotic Lactic Acid Bacteria from Cow Milk

A. A. Mahin, M. R. Khan and M. A. K. Sarker

Probiotics are live microorganisms which offer beneficial health effect and are used for treatment of various diseases. Milk is one of the sources of probiotics and therefore, this study focused on assessment of cow milk derived lactic acid bacteria (LAB) based on their in vitro probiotic properties. LABs in milk samples were isolated using MRS agar media supplemented with 0.5% $CaCO_3$. Further screening of the isolates was conducted with catalase test. Some probiotic properties of the isolates such as survivability of isolates in simulated gastric juice, intestinal fluid and bile salt, cholesterol lowering capability, surface hydrophobicity and auto-aggregation were also assessed. Initially 120 bacterial colonies with clear zone were isolated on $CaCO_3$ supplemented MRS as lactic acid producer among them 80 isolates showed catalase test. Then, 15 cellular and morphologically distinct isolates were assessed for their probiotic properties. 11 isolates showed >50% survivability in simulated gastric juice and intestinal juice, while 8 isolates showed >90% viability in 2% bile salt. 5 isolates showed >20% cholesterol lowering capacity, 6 isolates showed >50% surface hydrophobicity and 7 isolates exhibited >50% auto-aggregation. The undergone assessed M-7, M-8, M-16, M22, M-68, M-76, M-77, M-81 and M-86 isolates can be potential probiotics and therefore, further study related to identity, safety and applicability should be conducted.

1.4 Formulation of Cost Effective Microbial Culture Media using Kitchen Waste

Z. Mahal and T. Mumtaz

Kitchen wastes like fruit peels, vegetable stalks and egg shells are usually used for composting or simply disposed off as waste. Considering their nutritional values, these kitchen wastes can be utilized for the production of alternative microbial culture media. As the cost of conventional culture media is very high, use of these natural sources could make the media very cheap and can be used for the cultivation, maintenance and growth of microorganisms in the laboratory. Therefore, the aim of our present study is to replace the nutrient source of microorganisms using these locally available cheap materials, such as fruits and vegetables waste. The materials used in our study to make alternative culture media were peels of different fruits and vegetables e.g. Pomegranate, drum stick, pea pod and jute stems, egg shells. In our study the alternative kitchen waste media was prepared by adding one gm of each kitchen waste as powder after sun drying in 20 ml of warm distilled water for 2-3 hours to obtain the natural extract. Each solution was then filtered and 5 ml of this filtrate was taken in conical flask. The volume was made up to 100 ml using distilled water. pH of the media was adjusted to 6.5 - 7.0 by using pH meter. 2% of agar powder was added to the solution for solidification.For comparing the growth of microorganisms between commercial and our prepared kitchen waste media, we used different bacterial and fungi strains. For bacteria the test organisms were *Bacillus subtilis, E. coli, Listeria monocytogenes*and *Salmonella enteritidis*. Among these strains *Bacillus subtilis*and *E. coli* grow well in our prepared kitchen waste media and growth of *Listeria* monocytogenes, *Salmonella enteritidis* was slightly lower comparing to the commercial media. For fungi the test organisms used were *Penicilliumsp, Aspergillussp*and *Pleurotussajor-caju.*All fungi growth was faster on kitchen waste media compared to the commercially available potato dextrose agar media. From our study we can say that the development of alternative culture media can contribute to sustainability by using food waste. Further studies are ongoing tofind the chemical compositions of alternative media and biochemical characteristics of the fungi and bacteria indifferent alternative media and more test organisms will be used to identify the suitability ofusing these alternative nutrient sources as alternative general purpose culture medium.

2. Collaboration Work(s)

- Microbiolology Division has the following collaborative research projects/works
- 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 **"**Nuclear Techniques to Support Risk Assessment of Biotoxins and Pathogen Detection in Food and Related Matrices (D52044)" FY 2022-2026

3. Service Rendered and Revenue Income

No. of organization	Name of sample and service	No. of sample	Revenue income
7	Sample: Food/Feed Service: Microbiological analysis	14	76,200/-
8	Sample: Pharmaceutical Service: Microbiological analysis	8	27,600/-
Total		22	1,03,800/-

Radiation Entomology and Acarology Division, IFRB

Objective/Introduction

R & D activities of Radiation Entomology and Acarology Division focuses on development of environmentally safe integrated pest management techniques against agricultural insect pests of economic importance by using gamma radiation, sterile insect technique (SIT), biodegradable botanicals, hormones, pheromones, biological control agents and insecticides. REA division also working on cost effective insect feed for poultry and fish against soymeal, fishmeal protein and harmful tannery waste.

Activities

1. Research and Development Work(s)

1.1 ConductingSterile Insect Technique (SIT) Activitiesto Produce Safe, Non-Toxic and Healthy Dry Fish Production At Sonadia Island, Cox's Bazar

A. T. M. F. Islam, M. Hosain, M. S. Islam and M. Yasmin

Under this programme, from Oct. 2021 to Mar. 2022, approximately 25 lakh sterile files have been released in Sonadia. We have arranged awareness meeting on SIT and fish cleaning process with dry fish producers, traders and with different local organic farms. Hon'ble Member of Parliament (AshekUllahRafiq, Cox's Bazar-2 Maheshkhali-Kutubdia) exchange of views with dry fish producers, traders scientist, print and electronic Medias dignitaries with on application of SIT technology. Due to the control of harmful flies in dry fish through SIT method resulting in safe and healthy dry fish production, sising popularity of Sonadia dried fish, getting real price of dry fish, increasing the consumers' confidence, and producing the safe, healthy and non-toxic dried fish. Demand for Sonadia dried fish has increased in the country and abroad as the news of production of non-toxic dry fish in nuclear technology in Sonadia has been spread and published in print media and electronic media. It is imperative to take the following steps in the future to make the SIT technology sustainable and effective: to preserve the dry fish produced in the SIT method for a longer period of time, to ensure the quality of safe and healthy dry fish for marketing at home and abroad, to train the dry fish producers so that they can clean the fish properly, to transfer this technology with other governmental or non-governmental organization or NGO cooperates with the dry fish producers as a partner in this technology, we will cooperate with them. Finally Hon'ble Prime Minister has promised that Cox's Bazar's dried fish should be branded at home and abroad. To achieve that goal, branding of safe and healthy dry fish produced with SIT technology.

2.2 Study of Biology, Pupalcolourpolyohormism and Relationship Between Sex Ratio of The *Danauschrysippus* Butterfly (Lepidoptera: Danaidae) Under The Laboratory Conditions

M. S. Islam, M. Hosain and A. T. M. F. Islam

Danauschrysippus is commonly known as a plain tiger and belongs to the family Danaidae. The experiment was carried out at the laboratory of Radiation Entomology and Acarology Division (Institute of Food and Radiation Biology, Atomic Energy Research Establishment) maintained mean temperature of 26.16°C ±1.15°C with mean relative humidity (RH) 62.33 % ±1.29%. The incubation period of *Danauschrysippus* was 3.62±0.52days. The first, second, third, and fourth instar were kept for 2.98±0.11 days, 3.16±0.48 days, 3.19±0.41 days, and 3.57±0.45 days, respectively. The pupal period was 28.45±14.76 days, and the adult longevity of a male and female was 28.13±10.26 days and 28.45±14.76 days, respectively. 23 pupae were observed in three colours: green, pink, and an intermediate colour (between pink and green). Out of 23 pupae, 18 were pink (78.26%), 4 were brown (17.39%), and 1 was an intermediate colour (4.35%). The eighteen pink pupae gave rise to eleven males (61.11%) and seven females (33.89%). The 4 green pupae gave rise to 1 male (25%) and 3 females (75%). The one intermediate-coloured pupae gave rise to the female. The sex ratios regardless of the pupalcolour showed 12 males (52.18%) and 11 females (47.82%).

2.3 Impact of Nanoparticles (Titanium dioxide-TiO_2) on Mortality of *Callosobruchuschinensis* (Cpleoptera: Chrysomelidae)

M. S. Islam, M. Hossain and A. T. M. F. Islam

The bean weevil, *Callosobruchuschinensis* (Linnaeus, 1758), is a common species of beetle that is known to be a pest of many stored legumes. Excessive use of pesticides and chemical compounds has resulted in the development of resistance, comeback, and has a negative impact on the environment. In recent years, nanotechnology has emerged as one of the most promising new techniques to pest management. Present studies were conducted to determine the effectiveness of Titanium dioxide (TiO_2) nanoparticles (TNPs) against *Callosobruchuschinensis* adult's mortality on chickpea seed. Five concentrations of TNPs (0.5 1, 1.5, 2, and 2.5 g kg-1) used to evaluate mortality rate of *Callosobruchuschinensis*consequently after 1, 2, 4, 7, 14 days exposure. The results revealed that the nanoparticles (TiO_2) were highly effective on adults mortality rates; 95%, 99%, 98% were died at the concentration 1gm, 2gm and 2.5 gm/ kg^{-1} after one day of treatment, while dose 0.5gm and 1.5gm/kg^{-1} showed that the mortality rate 65% and 74% after one day treatment

respectively. We also observed no new progeny were developed in treated chickpea, but new progeny were found in the control group. All dosages had a substantial impact on *Callosobruchuschinensis* mortality and their associated interactions at the P<0.05 level.

2. Manpower Development and Training Programme

Title	Place	No. of participants
In- house training session	REA division	6

3. Seminar/Symposium/Conference/Workshop Attended

Name of the participant	Title of the event	Organizer	Date	Place
M. S. Islam	22nd International Biennial Conference andAGM 2021	Bangladesh Zoological Society	18 Mar. 2022	National Museum, Dhaka

4. Collaboration Work(s)

Agreement for academic co-operation between faculty of Science (5 years from Jun. 2020), Yamaguchi University, Japan and Institute of Food and Radiation Biology (No. IFRB- PCM5, REA-8) entitled "Ecological approach to the Lepidopteran insects in relation with environmental adaptation and population management".

Veterinary Drug Residue Analysis Division, IFRB

The 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. VDRAD also conducts research on the depletion of veterinary pharmaceuticals and radiometric analysis of their residues in animal matrices. In addition to these, the division provides relevant analytical services to stakeholders and regulators.

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/programme
- 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 Programme

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 and plant originated foods (fish, meat, milk, eggs, shrimp, rice, wheat, cereals, pulses, etc.) using CHARM II, ELISA, HPLC and LC-MS/MS systems provided by C. K. Shaha, M. M. B. Prince, D. Chakma, Dr. S. U. Talukder, M. H. Islam, Dr. M. N. Islam, Dr. M. J. Islam and Dr. A. S. M. Saifullah	Jul. 2021-Jun. 2022 (Eight hours per month)	IFRB, AERE	10-14

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

Name of the participant	Title of the event	Organizer	Date	Place
Dr. A. S. M. Saifullah	Kickoff meeting on "Strengthening Multi-Stakeholder Food Safety Monitoring Programmes for Chemical Contaminants and Residues in Plant and Animal Products Using Nuclear/Isotopic Techniques"	IAEA	27 Jan. 2022	Virtual
	Second research co-ordination meeting on "Depletion of Veterinary Pharmaceuticals and Radiometric Analysis of their Residues in Animal Matrices"	IAEA	28 Feb.- 4 Mar. 2022	Virtual

4. Collaboration Work(s)

- **Non RCA Project, Code: RAS5078**

  Title: "Enhancing Food Safety Laboratory Capabilities and Establishing a Network in Asia to Control Veterinary Drug Residues and Related Chemical Contaminants", Project counterpart: Dr. A S M Saifullah

- **Non RCA Project, Code: RAS5096**

  Title: "Strengthening Multi-Stakeholder Food Safety Monitoring Programmes for Chemical Contaminants and Residues in Plant and Animal Products Using Nuclear/Isotopic Techniques", Project counterpart and DTM: Dr. A S M Saifullah, Duration: 2022 to 2026.

- **IAEA Coordinated Research Project, Code: D52043**

  Title: "Depletion of veterinary Pharmaceuticals and Radiometric Analysis of their Residues in Animal Matrices", Chief Scientific Investigator (CSI): Dr. A S M Saifullah, Duration: 3 Mar. 2020 to 1 Jun. 2025.

- **IAEA TC Project, Code: BGD5034**

  Title: "Enhancing Competence in Nuclear and Complementary Capabilities for Testing/Monitoring Veterinary Drug Residues and Other Contaminants in Food", Project Counterpart: Dr. A S M Saifullah, Duration: 2022 to 2026.

- **S&TProject**

  Title: "Application of Graphene Oxide (GO) for the extraction and cleanup of Drug Residue in Food sample", Principal investigator: Dr. M. Jahurul Islam, Associate investigator: C. K. Shaha, period: 2021-2022.

5. Service Rendered and Revenue Income

Name of service provided	No. of sample	Revenue income
Sample Analysis	49	2,09,500/-
Irradiation of Food/Medical Product		
Total	49	2,09,500/-

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, salinity, and soil erosion. The objective of the research is to development of tissue culture techniques for the 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 plants with desired characteristics.

Activities

1. Research and Development Work(s)

1.1 Micropropagation of Gerbera (Gerbera spp.) using Callus Culture

Gerbera (*Gerbera jamesonii*) is a valuable ornamental species grown as a potted plant and for cut flowers. The flower "Gerbera" was named according to the name of German Scientist Tragoat Gerber. Gerbera is also known as *Transvaa Daisy, Barberton Daisy or African daisy*. It is a perennial herb, native to South Africa and Asia and belongs to the family Asteraceae. It is one of the most important commercial flowers, grown under a wide range of climatic conditions throughout the world. Due to its various colors, attractive size, and brightness, this flower is usually cultivated in various countries of the world for local as well as international flower trade markets. Among the commercial cut flowers, Gerbera has the longest vase life (10-15 days). It grows well in soil, soil-less culture and hydroponics. Gerbera created a great demand in the flower trade market of Bangladesh. The climatic condition and soil of Bangladesh are very favorable for commercial cultivation of Gerbera, but no concerted efforts has been made for the mass cultivation of this plant. On the other hand, significant work has not yet been done on Gerbera for its improvement either in agronomy or in *vitro* aspects. Besides this, no other reports are available for *in vitro* propagation of this plant in Bangladesh. The present project was taken to establish a small-scale gene bank in which an adequate number of pathogen-free gerbera saplings can be conserved easily in *vitro*conditions after the successful completion of mentioned experiments. Different explants viz. young capitulum, mid ribs of a leaf, shoot tips, flower heads, and inflorescence buds showed variable response to calli induction during culture onto MS medium fortified with various hormonal supplements. Among those explants, capitulum appeared best to callus induction when cultured onto MS medium fortified either with BAP + 2, 4-D or Kn + 2, 4-D at a concentration of 1 mg^{-1} each. The color of the calli was light greenish. The calli thus produce a different type of explants were maintained on the same medium by repeated subculture after every five weeks.

1.2 Effect of Different Doses of Cobalt-60 Irradiationon Biochemical Composition of Genotypes I-131-10 Sugarcane

The sugarcane (*Saccharumspp*.) is one of the oldest crops explored in Bangladesh and has been of great socio-economic importance. It belongs to the family Gramineae and also exports products from many developing countries. The sugarcane cv. I-131-10 used in this study was obtained from the Experimental Station of the Bangladesh Sugarcrops Research Institute, Ishardhi, Pabna. Sugarcane I-131-10 lines were irradiated with different doses (7Gy to 35Gy) of gamma irradiation. The aim of this study is to investigate the biochemical composition of the I-131-10 sugarcane line.The experiments and analysis was conducted using analytical grade reagents for the spectrophotometric analysis. Brix values ranged from 15.40±0.10 in the control sample to 19.90±0.10 from the sample irradiated with 35 Gy from a cobalt-60 source.The values of total reducing sugars ranged from 19.02±0.19 to 0.62±0.06%. Through analysis of the determination of reducing sugars and total reducing sugars is possible to obtain the sucrose content of sugarcane juice.

1.3 Study on The Yield and Yield Attributes of Carbon Ion Beam Irradiated B-11 Rice Genotypes

Sustainable rice (*Oryza sativa* L., 2n=24) production is the key to increasing food security in developing countries like Bangladesh as we face the onslaught of adverse climate change. It is the most extensively cultivated cereal crop covering around 77% of the total arable area in Bangladesh as it is the staple food in this country. But rice production is severely affected by biotic and abiotic stresses as 50% of the total rice-cropped land is rainfed in South Asia. Among the abiotic stresses, salinity is the main constraint for the sustainable production of rice. Therefore, the development of new rice cultivars with a high yield, good quality, and wide adaptation to this abiotic stress is badly required. Rice's genetic variety has shrunk due to the tremendous selection pressure applied in breeding since its domestication thousands of years ago. Obtaining new rice cultivars has therefore become a significant issue for breeders, and researching techniques to boost genetic diversity has drawn the attention of various research groups. Creating diversity through mutations has therefore become one of the most significant techniques for improving rice. Fourteen mutant lines of B-11 rice genotypes have been selected upon the carbon ion beam irradiation on the basis of improved agronomic traits. Early maturity rice was detected in the B-11 rice Mutant line at 140 days which is much lower than the parent (170 days).Plant height was also decreased drastically from 146 cm (parent) to 115.7 cm (average of mutant lines height). The important factor, seed setting % showed significant

improvements in the mutant population increasing from 54% (control plant) to 80.8 % in the case of an average of 14 mutants population. Panicle length changed insignificantly with the mutations. The most essential attribute in crop production is yield, and irradiation of rice genotypes increases yield by approximately double in most mutant lines compared to the control (4.2 t/ha).

2. Collaboration Work(s)

- MoU was made among BAEC and LalTeer Ltd., Bangladesh, and also Takasaki Advanced Radiation Research Institute, QST, Japan. The Objectives are to facilitate R&D activities including a mutation breeding programme with a view to developing new mutant varieties with a higher yield, improved agronomic traits, and adaptability to climate change.
- IAEA/RCA Project entitled, "Enhancing crop productivity and quality through mutation by speed breeding" RAS5088, to improve crop productivity and quality for enhancing food security and sustainable development of agriculture through the faster release of mutant varieties
- IAEA/RCA Project entitled, "Developing Bioenergy crops to optimize Marginal Land Productivity through Mutation Breeding and related Techniques" RAS5070, to create mutant(s)/advanced line(s) of sugarcane through gamma irradiation technique for obtaining improved cane yield for sugar production as well as bioethanol production
- IAEA/TC-Project entitled, "Strengthening capacity in the maintenance and utilization of the Tandem Accelerator Facility" IAEA/TC-BGD0010, to help to design the mutation breeding facility
- Forum for Nuclear Cooperation in Asia (FNCA) project on Mutation Breeding Project, to develop improved rice variety with higher yield and biotic & abiotic stress tolerance

Cytology and Biocontrol Research Group, IFRB

Objective/Introduction

- To study the combination of classical genetics approaches with cytology and cytogenetic strategies to identify active genes for various phenotypes of target dipteran insect pests
- To study the development of genomic resources for dipteran insects and emphasize how these resources can be used to understand their biology and management
- To improve management of economically important dipteran insect pests by the early career and established researchers engaged in advancing the discipline of entomology
- To increase the number of tools in the Area-Wide IPM toolbox by introducing novel techniques, studying existing ones, and/or modifying effective tools to new situations around the world

Activities

1. Research and Development Work

1.1 Study on Heterochromatin Bands in chromosomes of *Bactrocera Zonata* (Diptera: Tephritidae) in Bangladesh

Tephritid fruit flies (Diptera: Tephritidae) represent one of the major insect pest groups due to their world wide diversity and economic importance in agricultural sector. *Bactrocera zonata* is one of them and found in tropical, sub-tropical and temperate regions of the world including Bangladesh. In this study, we described a cytogenetic analysis of the heterochromatin bands in metaphase chromosomes of *B. zonata*. Karyotype exhibits variation in size and shape of the sex chromosomes. X chromosome length- 3.09µm and 3.50 µm for female and male of *B. zonata*, respectively; pericentric C-band with 18.33% heterochromatin block is observed in female X chromosome; in male, X chromosome has heterochromatin block (17.11%) in the centromere region. A faint telomeric C^+ band in the telomere region of the short arm is located in the X chromosome in both sexes. The telomeric band consists of 17.45% heterochromatin accumulation in female and 17.03% in male. The dot like Y chromosome is highly heterochromatic and in most cases full of c-heterochromatin. Cytogenetic information revealed from the study could improve role of heterochromatin in cytotaxonomy and evolutionary facts of the cryptic species of dipteran insects.

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

Name of the participant	Title of the event	Organizer	Date	Place
Dr. F. Yesmin and Dr. M. Hasanuzzaman	22nd International Biennial Conference & AGM 2021	Zoological Society of Bangladesh	18 Mar. 2022	Dhaka

Molecular Radiobiology and Biodosimetry Division, IFRB

Objective/Introduction

- To evaluate the radiation absorbed dose of the accidental radiation-exposed individual by analyzing the extent of chromosomal DNA damage
- To investigate the DNA damage repair mechanism in extremely radiation-resistant bacteria (e.g. *Deinococcus radiodurans*), whose findings could play important role in biomedical research like cancer and aging
- To find out the local variety or to develop the mutant variety of microbial strain that could be used for economic, health, and environmental benefits
- Tostudy metagenomics, epigenetics, gene expression profiling, microbial typing, protein purification, and characterization, etc.

Activities

1. Research and Development Work(s)

1.1 Molecular Analysis of Radiation-Resistant Bacteria from Pool Water ofRadiation Source Unit of AERE, Savar

S. Islam, A.Y. K. M. M. Rana, A. H. M. Kamal, M. Z. Rahman and P. K. Roy

Ionizing radiation causes DNA breakage and DNA replication inhibition, which are lethal to most organisms. After being exposed to high levels of gamma rays and UV light, certain bacteria retain enough protein activity to rearrange damaged DNA. Bacteria can evolve radiation-resistant systems as a result of constant ionizing radiation exposure. Due to natural selection, highly radioactive waste sites have a diverse microbiological population, including bacteria and fungi. We have identified a new bacterium in the pool water of a Co-60 Gamma source at Savar, Bangladesh. Water samples were grown in a TGY broth medium at twice strength. Bacterial suspension is used for radiation assay treatment. Identification was accomplished through morphological and physiological characterization, as well as phylogenetic analysis based on the 16S rRNA gene sequence. The rod-shaped cells were motile, spore-forming, and gram-positive. The newly identified isolate has a 99% resemblance to Bacillus spp. The isolates branched with distinct Bacillus cereus strains, according to the phylogenetic dendrogram. The isolates were gamma radiation-resistant up to 4 kGy. This is the first report of radiation-resistant bacteria of the species Bacillus isolated from the radiation source unit's pool water.

1.2 Study of Radiation Protection Activity of Honey in Probiotic Bacteria to be used in Cancer Therapy Patient

A. H. M. Kamal, S. Islam, M. Z. Rahman, P. K. Roy and A. Y. K. M. M. Rana

Honey shows radiation protection ability in both Zebra fish model and human trials by reducing DNA damage, apoptosis protein expression and some other mechanisms. In this study, honey was evaluated as a radiation protective agent for probiotic bacteria, as probiotic bacteria used for the treatment of radiation-induced diarrhea in cancer patients are also subjected to ionizing radiation, and a radio-protector will better stabilize their activity under radiation exposure. Honey, lactose and skim milk were used for the preparation of freeze-dried powder of probiotic bacteria *Lactobacillus rhamnosus*ATCC 53103 at specified concentrations and combinations, and they were irradiated at 1.5 kGy and bacterial counts were compared with un-irradiated powder. Honey showed the best radiation protection activity of all with only an 8% log reduction of probiotic count by gamma irradiation whereas control (No media), lactose (L), skim milk (SM), lactose plus skim milk combination (LSM) and honey plus skim milk combination (HSM) showed reduction of 100%, 20%, 14.77%, 19%, and 12.6 % respectively. Hence, incorporation of honey in the probiotic formulation is suggested to give double benefit by providing radiation protection to both probiotic bacteria and human host or cancer patient.

1.3 Computational Analysis of Hypothetical Protein from *Deinococcus Radiodurans (DR_0423)*

S. Islam, A. H. M. Kamal, M. Z. Rahman, P. K. Roy and A. Y. K. M. M. Rana

Deinococcus radiodurans is an extremophile bacterium which is well known for radiation-resistant. But numerous proteins from its genome are considered hypothetical proteins. Therefore, the present study aimed to reveal the functions of a hypothetical protein from the genome of *D. radiodurans*. Several bioinformatics tools were employed to predict the structure and function of this protein. Sequence similarity, secondary and tertiary structure were predicted and further validated with quality assessment tools. Furthermore, the active site and the interacting proteins were also explored with the utilization of CASTp and STRING server. The functional annotation exposed that the selected hypothetical protein could show DNA binding activity. At last, the current study depicts that the annotated hypothetical protein is linked with DNA repair activity which might be of great interest to the further research in bacterial genetics.

2. Manpower Development and Training Programme

Title of the event	Date	Place	No. of participants
In house training	Jul., 2021 - Jun, 2022	MRBD, IFRB	5

3. Seminar/Symposium/Conference/Meeting Attended

Name of the participant	Title of the event	Organizer	Date	Place
Dr. Z. Rahman, A. H. M. Kamal and S. Islam	Radiochemical Analyses Of Environmental Radioactivity	Hirosaki University	17 Aug. 2021	Online
Dr. A. Y. K. M. M. Rana, Dr. Z. Rahman, A. H. M. Kamal and S. Islam	Interregional Training Courses on Verification of SOPs for new serological and molecular techniques	IAEA, ZODIAC	21- 25 Feb. 2022	Online
	Regional Training Course on The Use of the IAEA Genetic Sequencing Services for member States	IAEA, ZODIAC	19-22 Apr. 2022	Online
	Virtual Interregional Workshop on the Current Developments of the Whole Genome Sequencing Platforms and the Bioinformatics Data Processing.	IAEA, ZODIAC	23-26 May 2022	Bangladesh

3. Collaboration Work

- S & T Project, entitled "Cytokinesis-block micronucleus (CBMN) based biodosimetry in mitogen-stimulated human lymphocytes", Principal investigator: Dr. M. Z. Rahman, Associate investigator: Dr. P. K. Roy (Group ID: MS - 573)
- R & D Project, entitled "Molecular Analysis of Radiation Resistant Bacteria Obtained from Radiation Source Unit of AERE, Savar", Project Director: S. Islam (Group ID: Biology, Medical Science and Nutrition - 19)
- IAEA RAS5085 Project, entitled "Using nuclear derived techniques in the early and rapid detection of priority animal and zoonotic diseases with focus on Avian Influenza", Project Counterpart (Cycle: 2020 - 2023): Dr. Protul Kumar Roy
- IAEA ZODIAC (Zoonotic disease Integrated Action) Project (Cycle: 2020 - 2025), ZODIAC National Coordinator: Dr. A. Y. K. M. Masud

INSTITUTE OF TISSUE BANKING AND BIOMATERIAL RESEARCH (ITBBR), AERE

Introduction

Every year thousands of people around Bangladesh suffer from burns, surgical wounds and bone associated complications. Clinically, healing these conditions requires bone and amniotic membrane allografts for transplantation.Institute of Tissue Banking and Biomaterial Research (ITBBR) dedicates all its' efforts to

relief human suffering through the production of clinically safe and cost-effective tissue allografts for the application in orthopedic surgery, oral & maxillofacial surgery, ophthalmology and burn& plastic surgery. Importantly, in recent years, ITBBR has started cranial bone autograft processing and banking. ITBBR has on-going research programme on biomaterials, such as amnion, human bone materials, bovine bone, rabbit collagen, various plant extract, shrimp chitosan and amniotic fluid derived and cord blood derived mesenchymal stem cells. In addition, ITBBR is trying to introduce the use of xenograft, synthetic graft, and artificial bone substitute in orthopedic reconstructive surgery.

Activities

1. Research and Development Work(s)

1.1 Procurement, Processing and Sterilization of Human Amniotic Membrane for Repair and Regeneration of Damaged Skin and Soft Tissue

M. L. Hossain, F. Diba, P. C. Karmakar, T. A. Arafat, M. H. Adnan, A.Siddika, M. Arifuzzaman, N. Akhtar and S. M. Asaduzzaman

Human amniotic membrane (HAM) is a well-established and widely used biological dressing material in reconstructive skin surgery, abdominal & vaginal reconstructions, plastic & cosmetic surgery and in ophthalmologic surgery. It has some unique properties including the facilitation of epithelial cells migration, the reinforcement of basal cell adhesion and the induction of epithelial differentiation. Amniotic sacs were retrieved from healthy and disease-free donor after normal vaginal deliveries. Then the amnionwas separated aseptically from chorion using sterile surgical instruments under aseptic conditions, washed several times (6-8 times) with sterile physiological saline, spread on sterile surgical gauge and oven dried at the temperature 40±1ºC for overnight. The dried membranes were cut into different standard sizes e.g., (20×10 cm, 10×10cm, 5×5 cm), triple packed in polythene envelopes, vacuum-sealed and labeled properly under the laminar flow cabinetand sterilized by gamma irradiation at the dose of 25 kGy.During the reporting period, 1161pieces of amniotic sacs were collected and 4233 pcs amniotic membrane allografts were prepared for clinical use in rehabilitative surgery.

1.2 Processing and Preservation of Allogenic Cancellous Bone Chips for the Treatment of Osteoconductive Filler of Bone Voids

A. Siddika, M. H. Adnan, F. Diba, T. A. Arafat, P. C. Karmakar, M. L. Hossain, M. Arifuzzaman, N. Akhtar and S. M. Asaduzzaman

Allogenic cancellous bone chips are considered as promising graft material for the management of difficult skeletal defects such as degenerative bone diseases, congenital deformities, bone fractures, gap non-union from traumatic accidents, cyst and cyst like tumor, spinal defects, oral and maxillofacial defects etc.Cancellous bones (femoral heads and condyles) were collected from clinically satisfactory live donors undergoing surgical treatment and then preserved temporarily in the hospitals under frozen conditions. After transported the bones to the tissue banking laboratory, femoral heads were then cut into pieces using a surface sterilized electric band saw under aseptic conditions. Radiation treatment is employed to inactivate or kill microorganisms on and/or tissue products. Bone tissues were pasteurized, processed, radiation sterilized and preserved according to the protocol set by ITBBR based on guidelines of International Atomic Energy Agency (IAEA). From July 2021 to June 2022, 10,134 ccradiation sterilized bone allografts were prepared for patients with orthopedic reconstruction.

1.3 Processing and Preservation of Radiation-Sterilized Cranial Bone Autograftfor Using in Skull Defect's Repairment

T. A. Arafat, P. C. Karmakar, M. L. Hossain, F. Diba, M. H. Adnan, A. Siddika, M. Arifuzzaman, N. Akhtar and S. M. Asaduzzaman

To repair the skull defects, autologous cranial bone is one of the most suitable substitutes in reconstructive surgery. The most common causes of skull defects include trauma, neurosurgical procedures and infections. ITBBR is an exclusive place for the processing and preservation of human cranial bone. Cranial bones were preserved under frozen condition (-80ºC) until processing began. For processing, the frozen cranial bones were thawed to room temperature and under aseptic condition. Then the bones were treated with povidone

iodine solution and washed several times with plenty of sterile distilled water, double packaged in polyethylene, vacuum sealed, wrapped with fabric and labeled with graft identification number, dose and date of gamma irradiation, preservation conditions, expiry date etc. Finally, the bones were packaged and vacuum-sealed in a third layer of polyethylene. Cranial boneswere sterilized by gamma radiation under frozen condition and were preserved at -80ºC and supplied to hospitals/clinics after sterility testing. During the period, 262 cranial bone autograftswere supplied to the hospitalized patients and using these autografts, patients suffering from the traumatic head injury, brain tumor and stroke were treated successfully.

1.4 Procurement and Preparation of Radiation Sterilized Demineralized Bone Granules for the Treatment of Oral and Maxillofacial Surgery

F. Diba, T. A. Arafat, P. C. Karmakar, M. L. Hossain, M. H. Adnan, A. Siddika, M. Arifuzzaman, N. Akhtar and S. M. Asaduzzaman

Demineralized bone matrix (DBM) has become a promising tool in the surgical management of maxillofacial bone defects. The DBM provides an osteoinductive proteins and growth factors as well as strong mechanical support. Moreover, risk of disease transmission with the use of DBM is very low.DBM has superior biological properties to be used as suitable graft material for the regeneration of maxillofacial bone because the removal of the mineral increases the osteoinductivity of the graft. ITBBR experts produce bone granule, whichwere then demineralized using 0.6N HCl. During the period, 30 vials demineralized bone granule were prepared for clinical use in oral and maxillofacial bone defects.

1.5 Microbial Quality Assurance of Radiation Sterilized Tissue Allografts

M. H. Adnan, F. Diba, T. A. Arafat, P. C. Karmakar, M. L. Hossain, A. Siddika, M. Arifuzzaman, N. Akhtar and S. M. Asaduzzaman

Effective transplantation of human tissue allografts offers recipients major improvements in their quality of life and sometimes even saves life. Contaminated allografts may lead to serious disease or even death of the recipient. To guarantee a consistent level of quality and good scientific practice, a tissue bank must provide optimized technical solutions for the acquisition, storage, documentation, and transfer of graft materials. The application of gamma irradiation for the terminal sterilization of tissue allografts is well accepted because the process control is precise and the method leave no residue in the treated product. Based on the initial bioburden level and radiation response of the contaminants, 25 kGy gamma radiation was found suitable for the sterilization of tissue allografts processed in ITBBR.In the reporting period, 516 amnion samples from 22batches and 893 bone samples from 33 batches and 362 cranial bone samples from 23 batches were tested. All samples were found microbiologically safe for transplantation.

1.6 Fabrication and Physiochemical Characterization of Hydroxyapatite- Based Scaffold for using in Drug Delivery System ofBone Tissue Engineering

P. C. Karmakar, M. L. Hossain, F. Diba, T. A. Arafat, M. H. Adnan, A. Siddika, M. Arifuzzaman, N. Akhtar and S. M. Asaduzzaman

The development of biocompatible scaffolds for drug delivery systems is rapidly emerging in several fields of human health especially for the treatment of different disorders related to bone defects such as osteomyelitis. In this study, silver nanoparticle incorporated scaffold with a composition of hydroxyapatite (HA), chitosan, and polyvinylpyrrolidone (PVP) was fabricatedthrough thermally induced phase separation technology, which can be used as a drug delivery system. Different physicochemical properties such as porosity, density, swelling ratio, and biodegradability as well as blood biocompatibility test, brine shrimp lethality test, and antibacterial activities were determined which showed the scaffolds were compatible to use. As a drug delivery system, the scaffolds were loaded with ceftriaxone (Cef) and it's*in vitro* release study was conducted. From this study, it was evident that selected scaffolds had good porosity, desirable density, and good swelling rate with a biodegradation rate of about for 21 days, all of which would meet the basic requirements for osteogenesis and drug delivery system. The scaffolds showed antibacterial activities against *E. coli*, *Staphylococcus aureus* and *Pseudomonas aeruginosa*. The brine shrimp lethality tests exhibited minimal toxicity and our formulated scaffolds were RBC biocompatible. A sustained release of Cefwas observed after 4 days and about 60.30± 2.15 %drug was released within 14 days. The above results indicated that these promising silver nanoparticlesincorporated hydroxyapatite-chitosan-PVP scaffolds could be used in the

applications of bone tissue engineering as drug delivery matrix.

2. Seminar/Symposium/Conference/Meeting Attended

Name of the participant	Title of the event	Organizer	Date	Place
Dr. S.M. Asaduzzaman	Public and Professional Awareness on Tissue Banking Activities in Bangladesh	ITBBR AERE, Savar	29 Jun. 2022	Sheikh Fazilatunnessa Mujib Memorial KPJ Specialized Hospital, Kashimpur, Gazipur

3. Public and Professional Awareness Activities

In our country, the majority people are not familiar with the concept of tissue transplantation. To make the concept of tissue transplantation acquainted and to inspire tissue donation, seminars were organized at different hospitals. Beside these, discussion meetingswere arranged regularly with surgeonsto increase professional awareness.

4. Service Rendered and Revenue Income

Nature/name of service	No. of sample	Income
Supply of bone tissue allografts (cc)	12904	6,45,200/-
Supply of amniotic membrane allografts (pcs)	2183	65,490/-
Total		7,10,690/-

NUCLEAR MEDICINE

NATIONAL INSTITUTE OF NUCLEAR MEDICINE AND ALLIED SCIENCES (NINMAS), SHAHBAG

Objectives

- To render specialized medical services to the people using nuclear technology
- To improve and upgrade Nuclear Medicine facilities in Bangladesh
- To conduct training of physicians, physicists radio pharmacists and technologists in the field of nuclear medicine
- To conduct academic and research activities
- To coordinate and standardize

Activities

1. Clinical Services

Diagnostic Activities

- 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 the vascular system are

routinely performed.

- Hormone Analysis: By using the RIA and modern CLIA techniques the In-vitro division is estimating all thyroid-related hormones like T3, T4, TSH, FT3, FT4, LH, FSH, pituitary hormones, estrogen, progesterone, prolactin, testosterone, follicular stimulating and luteinizing hormones, Vitamin D, parathormone 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).

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 Activities

- NINMAS is the only institute in the country where postgraduate degrees like MD (Nuclear Medicine) courses have been conducted for medical graduates under Bangabandhu Sheikh Mujib Medical University (BSMMU). In the last academic session, eight (8) residents were admitted for MD course of 5 years duration. In 2022, 4 doctors have successfully obtained their post-graduate MD degree.
- One Physician from abroad has been doing his MD (Nuclear Medicine) after completion of his IAEA fellowship training in NINMAS
- Weekly journal review as a continuous education programme was conducted on recent Nuclear Medicine & Allied Sciences related works regularly in this institute
- Scheduled lectures were delivered routine to post-graduate students (MD, MS) of different disciplines of BSMMU, BIRDEM, NIKDU, NICVD, NSH, NICRH, NICDH and Heart Foundation and students are placed for 15-30 days for practical demonstration
- Collaborator of the 'Multi-Disciplinary Team Approach consultation between oncologists, Head neck surgeons, Pathologists and palliative care units along with Nuclear Medicine specialists of NINMAS for clinical management of complicated and academic cases
- Collaborator of the training programme for work safety in a COVID-19 pandemic crisis

3. Production of Radiopharmaceuticals at Cyclotron Facility

IBA Cyclone 18/9 is a dual particle accelerator/cyclotron whose proton energy is 18 MeV and deuteron energy is 9 MeV. This IBA cyclotron was commissioned in the basement of the F Block at BSMMU campus which is operated by NINMAS, BAEC. The cyclotron is capable to produce positron emitter's radionuclide, namely, ^{18}F, ^{15}O, ^{13}N, ^{11}C and other isotopes from solid targets for Positron Emission Tomography (PET) imaging. Presently the cyclotron has been exclusively used for the production of ^{18}F for ^{18}F-FDG PET imaging. ^{18}F-FDG is supplied to the NINMAS, INMAS, Dhaka, Combined Military Hospital (CMH), Evercare Hospital Dhaka (EHD), Medinova Medical Services Limited and Institute of Nuclear Medical Physics (INMP), Savar regularly twice a week The Cyclotron facility is also capable of producing ^{18}F-NaF, ^{18}F-FLT and ^{18}F-MISO.

4. Research and Development Work(s)

4.1 The Impact of COVID-19 on the Thyroid Function

Z. Jabin

Currently, we know that SARS-CoV-2 could lead to short-term and reversible thyroid dysfunction, but thyroid diseases seem not to affect the progression of COVID-19. The thyroid gland and the virus infection

with its associated inflammatory-immune responses are known to be engaged in complex interplay. SARS-CoV-2 uses ACE2 combined with the transmembrane protease serine 2 (TMPRSS2) as the key molecular complex to infect the host cells. Interestingly, ACE2 and TMPRSS2 expression levels are high in the thyroid gland and more than in the lungs. Adequate management of patients with thyroid diseases remains essential during the pandemic, but it could be compromised because of healthcare service restrictions. Sin4ce the beginning of the pandemic, we continuously tried to recognize and classify priority cases for in-person visits at NINMAS and maintain therapeutic procedures. Telemedicine services appeared to be a useful tool for managing patients not requiring in-person visits.

4.2 Sternal Bone Metastases from Differentiated Thyroid Carcinoma: A Single Institutional Experience

Z. Jabin, J. Ferdous, Z. U. Rasha, M. A. Sattar and F. Begum

The incidence of distant metastases from differentiated thyroid cancer (DTC) is not too high. Sternum, manubrium, clavicles are close to neck area and loco-regional hematogenous spread are often unstoppable. Treatment dilemma, multidisciplinary team approach and experiences with few exceptional cases of DTC with metastases to the sternum are being followed up to observe the outcome. Some patients were treated with difficulties as they were resistant to radio-iodine therapy (RAIT). Sternal resection for metastasis followed by RAIT with or without radiotherapy appears to offer prolonged survival with improved quality of life (QOL). 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 DTC (mostly 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.

4.3 How Telemedicine Evolved the Management of Differentiated Thyroid Cancer through Nuclear Medicine Facilities at NINMAS During Covid-19 Pandemic

Z. Jabin, J. Ferdous, U. Islam, S. Nahar and F. Begum

In Mar. 2020, worldwide pandemic of coronavirus disease 2019 (COVID-19) was confirmed in Bangladesh. Since then, the pandemic has spread over the whole country and the number of affected people increased. Besides strict lockdowns, general holidays, and vaccinations against COVID-19, new waves of pandemic with newer strains are observed, thus putting the health system in serious challenges. NINMAS promptly opted for telemedicine service (TMS) since Apr. 2020 along with selective presence of the patients on appointment basis. The purpose of this study is to explore how TMS impacted the management of differentiated thyroid cancer (DTC) in a tertiary center during pandemic.

4.4 Dosage, Administration, Side Effects and Precautions of Propylthiouracil (PTU) Administration in Hyperthyroid Patients

Z. Jabin

Hyperthyroidism progresses rapidly and once diagnosed, treatment must be taken as soon as possible. Anti-thyroid drugs (ATDs) are used for the treatment of hyperthyroid patients for maintaining euthyroid status by preserving the thyroid function and reduce the possibility of hypothyroidism. Previously, Neomarcazole was the only available ATD in Bangladesh but now Methimazole (MMI) and propylthiouracil (PTU) are being used successfully. Both MMI and PTU are effective inhibitors of thyroid iodide peroxidase, which can catalyze the biosynthesis of thyroid hormone from the initial step. PTU has an inhibitory effect on peroxidase and the iodization of tyrosine in thyroid, thereby restrains the synthesis of T4 and interferes with the transformation of T4 to T3. PTU is preferred in the first trimester of pregnancy to lessen the risk of teratogenicity. It is generally well tolerated, with occasional side effects related to the skin including rash, itching, hives, abnormal hair loss, and skin pigmentation. Other common side effects are swelling, nausea, vomiting, heartburn, loss of taste, joint or muscle aches, numbness and headache, allergic reactions, and hair whitening

4.5 Assessment of Neoadjuvant Chemotherapy Response in Locally Advanced Breast Cancer (LABC) in Comparison with MRI Versus Whole Body PET/CT

S. M. F. Bedum, T. Mandal and P. Mutsuddy

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.

4.6 Assessment of Neoadjuvant Chemotherapy Response in Locally Advanced Breast Cancer (LABC) in Comparison with MRI Versus Whole Body PET/CT

S. M. F. Bedum, T. Mandal, P. Mutsuddy and M. Ahmed

Description: 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.

4.7 TN-RAS6093-1901188 - Strengthening Capacity to Manage Non-Communicable Diseases Using Imaging Modalities in Radiology and Nuclear Medicine (RCA)

M. A. B. Siddique, T. Mandal, P. Mutsuddy and R. Afrin

The study targets to enhance capacity to diagnose non communicable diseases (NCDs) using radiology and nuclear medicine. This study will contribute to the better management (diagnosis and treatment) of NCDs in the RCA region, and a reduction of premature mortality.

4.8 Outcome of Radioactive Iodine Therapy in Patient with Differentiated Thyroid Carcinoma Associated with B-RAF Mutation

P. Akhter

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. The entire 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.

4.9 Radionuclide Neuroimaging of Autism Spectral Disorder's (ASD) - a Grand Opportunity to Improve Diagnosis and Management using Affordable Advanced Technology in Bangladesh

N. Sultana

While more than 3,000 children are born worldwide with autism every day, the Government of Bangladesh has made an eminent affirmation of its responsibility in this realm with a master plan to utilize current research and intervention (Hasina 2011, National Strategic Plan for Neurodevelopmental Disorders 2016-2021). Nuclear Neuroimaging has the capability to be utilized as a tool for specific diagnosis of autism but also as a tool for assessment of response to drug and non-drug therapies. National Institute of Nuclear Medicine & Allied Sciences, BAEC, BSMMU campus with its equipment and expertise holds the eligibility to be added as a unique dimension to the Government's endeavor to conquer autism.

4.10 Therapeutic Response and Long-term Outcome of Differentiated Thyroid Cancer with Regional Lymph node Metastases Treated by Radioiodine Therapy

J. Ferdous

Differentiated thyroid carcinoma (DTC) is one of the most common types of endocrine cancer. Its clinical manifestations are relatively occult, and the early detection will obtain a better prognosis. Lymph nodes are the most common site of metastasis. Complete surgical resection followed by radioactive iodine (^{131}I) therapy (RAIT) is the main method for the treatment of DTC with lymph node metastases along with thyrotropin

suppression by levothyroxine. The purposes of this study are: i) to assess the therapeutic response of radioiodine treatment of DTC patients with lymph node metastases ii) to investigate the prognostic factors iii) to evaluate the disease-free state.

4.11 Empowering Regional Collaboration Among Radiotherapy Professionals Through Online Clinical Networks (RCA), IAEA/RCA Project RAS6096

S. Sharmin and N. F. Ali

- Congenial harmonics established between 28 country counterparts in preparatory meeting of First Virtual Tumour Board. First Virtual Tumour Board and kick off for ASPRONET (Asia Pacific Radiation Oncology Network).
- ASPRONET Cases shared in online VTB
- CLP4NET Moodle platform launched with know-hows as a case discussion
- CLP4NET provides academic information setting an online education forum for all experts partaking.

Global online cooperation established between multinational panel of experts with active discussion on complex clinical scenarios

4.12 M-Health in Management of Post-Surgical, Post Ablative Cases of Differentiated Thyroid Carcinoma- An Institutional Review", MPH in Epidemiology Research Proposal, Bangladesh University of Health Sciences (BUHS)

N. F. Ali, F. Rahman and S. N. Bailey

The Corona pandemic has set the world into turmoil and even more so the health system. Regular visits for patient follow-up is a risk for both health care provider and patient. Telemedicine and m-health have proved an amazing hospital management alternative cutting patient costs in terms of travel expenses and nosocomial infections. Simultaneously it saves work hours that are otherwise lost in travel.

This institutional review highlights these very aspects with respect to Differentiated thyroid carcinoma cases undergoing telemedicine follow ups at the National Institute of Nuclear Medicine and Allied Sciences (NINMAS), Bangladesh Atomic Energy Commission (BAEC). The employed platforms for patient follow-ups include WhatsApp and the LIS system of patient reporting modality.

4.13 Characterization Of Loss Of Parathyroid Gland During Total Thyroidectomy In The Management of Differentiated Thyroid Carcinoma

S. N. Bailey, F. Rahman and N. F. Ali.

The goal of my work is to promote preservation of parathyroid gland in differentiated thyroid carcinoma patients as their calcium metabolism is a tedious and cumbersome correctional process afterwards. To open new windows for the exploration of the aforementioned territory in other affiliated institutes to broaden the spectrums of medical intervention

4.14 In-house Researches

- Evaluation of PET-CT in gastrointestinal carcinoma- Prof. Dr. Shamim Momtaz Ferdousi Begum, Dr. Abu Bakker Siddique and coworkers
- Role of F18 FDG PET-CT scan in diagnosis of Carcinoma of Unknown Primary (CUP)- Prof. Dr. Shamim Momtaz Ferdousi Begum, Prof. Dr. Abu Bakker Siddique, Dr. Tapati Mandal, Dr. Pupree Mutsuddy
- 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
- Assessment of myocardial viability/hibernating myocardium by F18 FDG PET metabolic imaging- Prof.

Dr. Shamim Momtaz Ferdousi Begum, Prof. Dr. Abu Bakker Siddique, Dr. Tapati Mandal

- 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 anti TgAb levels in Thyroid Carcinoma Patients, Prof. Dr. Fatima Begum and coworkers
- Prognostic evaluation of CAD by F18 FDG PET after revascularization- Dr. Shamim Momtaz Ferdousi Begum, Prof. Dr. Abu Bakker Siddique, Dr. Tapati Mandal
- 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
- F-18 radioisotope production with ‘‘Cyclone 18/9 MeV IBA Cyclotron’’ Installed at NINMAS, Prof. Ferdoushi Begum, Nahid Hossain and coworkers
- Assessment of Environmental Toxicity of Some Waterfall Areas of Bangladesh by PIXE Technique and Radionuclides detection Using Gamma Spectrometry. PhD Research work. Prof. Ferdoushi Begum.
- Development and Upgrading of Hot-lab facilities of NINMAS; Prof. Ferdoushi Begum, Md. Nahid Hossain and coworkers.
- Development of the shielding structure at the different lab of the institute to ensure the minimum radiation dose in the room. Prof. Ferdoushi Begum, Md. Nahid Hossain and coworkers
- Screening of Congenital Hypothyroidism, Dr. Mohammad Anwar-Ul-Azim and coworkers
- Evaluation of Physiochemical & Microbiological Stability and Quality of 2- [^{18}F] Fluoro-2-Deoxy-D-Glucose ([^{18}F] FDG): Synthesized by 18MeV Cyclotron facility of National Institute of Nuclear Medicine and Allied Sciences (NINMAS, Anwar-ul-Azim and coworkers
- Establishment of a RT-PCR Laboratory under IAEA Regional Cooperation Project (INT0098), Anwar-ul-Azim and coworkers
- External Quality Assurance Services (EQAS) Proficiency Testing for Immunoassays is Being Performed at CLIA Laboratory of In-Vitro Division, Anwar-ul-Azim 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
- F18 FDG PET-CT scans in patients with colorectal cancer and their staging, Prof. Dr. Shamim Momtaz Ferdousi Begum and coworkers
- F18 FDG PET-CT scans in extra-nodal lymphoma involvement, Prof. Dr. Shamim Momtaz Ferdousi Begum and coworkers

5. Arranged Training Programme/Workshop/Seminar/Symposium/Conference

Title of the event	Date	Place	No. of Participants
In-house training of the employees of NINMAS for assuring covid-19 health safety and awareness	Jul. 2021	NINMAS	32
TEIN Lecture series 2021 2nd Semester Bangladesh- KOICA Workshop on Clinical Nuclear Medicine	01 Sep. - 24 Nov. 2021	NINMAS and KOICA	35
Public hearing with live interaction of patients and attendants as a stakeholder of the services provided by NINMAS	16 Nov. 2021 and 6 Mar. & 16 Jun. 2022	NINMAS	30

In-house Training Course on Office Manners as a part of National Integrity Strategy of Bangladesh Government	Jul. 2021- Jun. 2022	NINMAS	180 (group wise)
In-house training course on office manners and general behavior –II	6-7 Dec. 2021	NINMAS	45
Training on Dried blood spot (DBS) sampling, preservation and diagnostic procedure for Congenital Hypothyroidism Screening	23 Dec., 2021	NINMAS	150
TEIN 2022 Bangladesh- KOICA Winter Workshop on Clinical Nuclear Medicine	27 Jan. 2022	NINMAS and KOICA	35
TEIN Lecture Series 2022, 1st Semester Bangladesh- KOICA Workshop on Clinical Nuclear Medicine	2 Mar.-25 May 2022	NINMAS and KOICA	35
Training on Dried blood spot (DBS) sampling, preservation and diagnostic procedure for Congenital Hypothyroidism Screening	8 Jun. 2022	NINMAS	200
Training on Radioimmunoassay (RIA)	28-29 Jun. 2022	NINMAS	2

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

Name of the articipant	Title of the event	Organizer	Date	Place
Prof. F. Begum	Workshop on Development/Update of Training Module Related to International Health Regulation (IHR-2005) programme	Directorate General of Health Service	14, 16, 27, 28, 30 Sept., 2021	Mohakhali, Dhaka
	Consultative meeting for International Health Regulation (IHR-2005) focusing on implementation of IHR core capacioties	IEDCR	22-23 Dec. 2021	IEDCR
Dr. F. Begum	Application Training of Color Doppler Ultrasound Machine	Ultrasound Division NINMAS	5 Dec. 2021	NINMAS
	Scientific Seminar on Women's Health	Bangladesh Endocrine Society	8 Mar. 2022	Dhaka Club
Dr. R. Perveen	Training on High End Premium Level 4D Color Doppler Machine.	MST	20-29 Dec. 2021	NOIDA, India
M. N. Hossain, M. S. Mia and H. Mahdi	Advanced Training on Cyclotron (Operation and Maintenance)	IBA, Belgium	21 Mar. - 01 Apr. 2022	Louvain-la-Neuve, Belgium
M. A. Azim, M. J. Uddin, S. C. Biswasarma, S. Khatun, M. A. Kabir and M. S. I. Akhand	GSP, DBS and Panthera Puncher Customer Training	Turku, Finland	4-12 Apr. 2022	Turku, Finland
M. A. Azim, M. J. Uddin, S. C. Biswasarma, S. Khatun and S. I. Akhand	Training on "[^{18}F]-FDG QC Kit Utilization	Cyclotron and Radiochemistry Laboratory, NINMAS	04-09 Jun. 2022	NINMAS
Dr. S. M. F. Begum, Dr. S. Sultana, Dr. F. Begum, Dr. A. K. M. F. Bari, Dr. Z. Jabin, Dr. S. Quddus, Dr. M. A. B. Siddique, Dr. R. Perveen, Dr. P. Akhter, Dr. U. Islam, Dr. F. Haque, Dr. T. Mandal, Dr. P. Mutsuddy, Dr. J. Ferdous, N. F. Ali and S. N. Bailey	Bangladesh: KOICA TEIN Lecture Series 2nd Semester. Weekly one Seminar for 3 Months	NINMAS, Dhaka and KOICA	01 Sept.-24 Nov. 2021	Virtual

Name of the articipant	Title of the event	Organizer	Date	Place
Dr. S. M. F. Begum	Penal Expert- Scientific Seminer on Magnesium & Vitamin D- An Unsighted Mystery	BSMMU	11 Oct. 2021	BSMMU, Dhaka
Dr. S. M. F. Begum, Dr. S. Sultana, Dr. F. Begum, F. Begum, Dr. A. K. M. F. Bari, Dr. Z. Jabin, Dr. N. Sultana, Dr. S Quddus, Dr. M. A. B. Siddique, Dr. J. Ferdous, N. Hossain, Dr. T. Mandal, Dr. R. Perveen, Dr. P. Mutsuddy, Dr. U. Islam, Dr. P. Akhter, Dr. F. Haque, Dr. P. Mutsuddy, N. F. Ali and S. N. Bailey	2022 Bangladesh-KOICA Winter Workshop on Clinical Nuclear Medicine	NINMAS, Dhaka and KOICA	27 Jan 2022	NINMAS
Dr. S. M. F. Begum, Dr. S. Sultana, Dr. F. Begum, Dr. A. K. M. F. Bari, Dr. Z. Jabin, Dr. S. Quddus, Dr. M. A. B. Siddique, Dr. R. Perveen, Dr. P. Akhter, Dr. U. Islam, Dr. F. Haque, Dr. S. Quddus, Dr. T. Mandal, Dr. P. Mutsuddy, Dr. J. Ferdous, N. F. Ali and S. N. Bailey	TEIN Lecture Series 2022, 1st Semester Bangladesh- KOICA Workshop on Clinical Nuclear Medicine	NINMAS, Dhaka and KOICA	02 Mar.-25 May 2022	NINMAS
Dr. S. M. F. Begum, Dr. S. Sultana, Dr. F. Begum, Dr. A. K. M. F. Bari, Dr. Z. Jabin, Dr. S. Quddus, Dr. M. A. B. Siddique, Dr. R. Perveen, Dr. P. Akhter, Dr. U. Islam, Dr. F. Haque, Dr. S. Quddus, Dr. T. Mandal, Dr. P. Mutsuddy, Dr. J. Ferdous, N. F. Ali and S. N. Bailey	PET-CT in Lymphoma	SNMB	01 Apr. 2022	Webinar
Prof. Dr. F. Begum, Dr. Z. Jabin, M. Anwar-ul-Azim, M. J. Uddin, S. C. Biswasarma, U. Islam and P. Akhter	International Conference on Physics in Medicine	BMPA and BAEC	26-27 May 2022	AEC, Dhaka
Dr. J. Ferdous, P. Akhter and U. Islam	Therapeutic Nuclear Medicine	SNMB	21 Jul. 2021	Vitual
	NMS(S) International CME Webinar on Applications of Multimodality Molecular Imaging	Nuclear Medicine Society, Singapore	8 Aug. 2021	Virtual
	Webinar on First Trimester Anomalies. Lukhnow ultrasound Courses by dr. Ashok Khurana, Dr. Ladbans & Dr. PK Srivastava	Yashdeep Ultrasound lab.	17 Sept. 2021	Virtual
	ANMPICON-2021	AIMS, India	17-18 Sept. 2021	Virtual
	Emirates international Virtual Conference in Nuclear Medicine, Molecular imaging and Theranostics	Dubai Health Athority	24-25 Sept. 2021	Virtual
	33rd National Conference and Annual General Meeting	BSU	8 Oct. 2021	Virtual
	The 20th Annual General Meeting of the Asian Regional Cooperative Council for Nuclear Medicine (ARCCNM)	ARCCNM	1-3 Nov. 2021	Virtual
Dr. S. M. F. Begum, Dr. S. Sultana, Dr. F. Begum, Dr. A. K. M. F. Bari, Dr. N. Sultana, Dr. Z. Jabin, Dr. M.	**Webinar:** World Thyroid day 2022	NINMAS	25 May 2022	NINMAS

Name of the articipant	Title of the event	Organizer	Date	Place
A. B. Siddique, Dr. S. Quddus, Dr. R. Perveen, Dr. P. Akhter, Dr. U. Islam, Dr. F. Haque Dr. T. Mandal, Dr. P. Mutsuddy, Dr. J. Ferdous. N. F. Ali and S. N. Bailey				
M. N. Hossain	International Conference on Accelerators for Research and Sustainable Development: from Good Practices towards Socioeconomic Impact	IAEA	23-27 May 2022	IAEA
Dr. S. M. F. Begum, Dr. S. Sultana, Dr. F. Begum, Dr. S. Quddus, Dr. M. A. B. Siddique, Dr. R. Perveen, Dr. P. Akhter, Dr. Dr. U. Islam, Dr. F. Haque, Dr. T. Mandal, Dr. P. Mutsuddy, Dr. J. Ferdous, N. F. Ali and S. N. Bailey	Launching Ceremony of Metirox by Renata Limited on Dossage, Administration, Side Effects & Precautions of Methimazole Administration	Renata Limited	21 Sept. 2021	NINMAS
Dr. S. M. F. Begum, Dr. S. Sultana, Dr. F. Begum, Dr. M. A. B. Siddique, Dr. S. Quddus, Dr. R. Perveen, Dr. P. Akhter, Dr. Dr. U. Islam, Dr. F. Haque, Dr. T. Mandal, Dr. P. Mutsuddy, Dr. J. Ferdous, N. F. Ali and S. N. Bailey	Scientific Luncheon Programme by Nuvista Pharma on the Role of Magnesium on Human Health, Specially Thyroid Function"	NUVISTA Pharma	16 Sept. 2021	NINMAS
Dr. S. M. F. Begum, Dr. S. Sultana, Dr. F. Begum, Dr. Z. Jabin, Dr. S. Quddus, Dr. M. A. B. Siddique, Dr. M. A. Azim Dr. R. Perveen, Dr. P. Akhter, Dr. Dr. U. Islam, Dr. F. Haque, Dr. T. Mandal, Dr. P. Mutsuddy, Dr. J. Ferdous, M. J. Uddin, S. C. Biswasarma, N. F. Ali and S. N. Bailey	25th National Conference Society of Nuclear Medicine	SNMB	20 May 2022	BICC, Dhaka
Dr. S. M. F. Begum, Dr. S. Sultana, Dr. F. Begum, Dr. Z. Jabin, Dr. S. Quddus, , Dr. M. A. B. Siddique, Dr. M. Anwar-ul-Azim Dr. R. Perveen, Dr. P. Akhter, Dr. Dr. U. Islam, Dr. F. Haque, Dr. T. Mandal, Dr. P. Mutsuddy, Dr. J. Ferdous, M. J. Uddin, S. C. Biswasarma, N. F. Ali and S. N. Bailey	5th National Conference and Annual General Meeting	BTS	17 Jun. 2022	Pan Pacific Sonargaon Hotel, Dhaka

7. Collaboration Work(s)

7.1 IAEA TC Project

- IAEA Technical Cooperation (TC) project (BGD6028): "Developing Human and Infrastructure for Cyclotron based Diagnostic Positron Emission Tomography Radiopharmaceuticals Production and Radiation Treatment Facilities for Cancer Patients", Dr. Mohammad Anwar-Ul-Azim,
- IAEA Technical Cooperation (TC) Project "Promoting the Preparation of Emerging Radiopharmaceuticals for Positron Emission Tomography-Based Molecular Imaging and Radionuclide Therapy (RAS6090)". Dr. Mohammad Anwar-Ul-Azim.

7.2 RCA Project

- 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).

7.3 CRP 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)"; Chief Scientific Investigator, Prof. Dr. Shamim Momtaz Ferdousi Begum.
- Chief Scientific Investigator of Coordinated Research Project (CRP) "Enhancing Capacity of Neuroimaging & Biomarkers: Application in early stage Alzheimer 's disease with comorbidities". Code No. E13043. IAEA Research Contact No. 20402. Dr. Nasreen Sultana.

7.4 KICA Project

- KOICA (Department of Foreign Affairs, KOICA Grant) project on "Enhancement of Nuclear Medicine Infrastructure Using Asia Connect in Bangladesh" Ongoing; Leader and Co-Principal Investigator of Bangladesh: Prof. Dr. Shamim Momtaz Ferdousi Begum.

7.5 MoST Project

- "Congenital Hypothyroidism Screening in New Born Babies (phase-2)" an ADP project of Ministry of Science and Technology Implement by BAEC at NINMAS, Project Director: Dr. Mohammad Anwar-Ul-Azim.
- Involved in Science and Technology Project ''Performance Evaluation of Nuclear Medicine Imaging Modalities and Development of Functional Capability with Image Quality'' as an Investigator: Md. Nahid Hossain, Prof. Ferdoushi Begum.
- "Evaluation of Physiochemical & Microbiological Stability and Quality of 2- [^{18}F] Fluoro-2-Deoxy- D-Glucose ([^{18}F]FDG): Synthesized by 18MeV Cyclotron facility of National Institute of Nuclear Medicine and Allied Sciences (NINMAS)", Dr. Mohammad Anwar-Ul-Azim

8. Arranged Stakeholder Meeting(s)

- Arranged stakeholder meeting at the Institute of Nuclear Medicine and Allied Sciences (INMAS), Dhaka on 23 Dec. 2021
- Arranged stakeholder meeting at National Institute of Nuclear Medicine and Allied Sciences (NINMAS), Dhaka on 8 Jun. 2022

9. Arranged Public Hearing Meeting(s)

- Arranged public hearing with the patients and attendants at NINMAS auditorium as a part of National Integrity Strategy on 16 Nov. 2021, 5 Mar. 2022 and 16 Jun. 2022.

10. Repair, Maintenance and Renovation Works

- Oversee the QC Programme of Nuclear Medicine Instruments and Assisted in repair and Maintenance of various equipment. Prof. Ferdoushi Begum, Md. Nahid Hossain and Coworkers
- Took part in the Development and Upgrading of Hot-lab facilities, Prof. Ferdoushi Begum, Md. Nahid Hossain and Coworkers
- Prepared instrument's present and past status, Prof. Ferdoushi Begum, Md. Nahid Hossain and Coworkers

11. Others

- Organized laboratory for routine clinical Facilities works as well as R&D
- Ensure radiation safety for the patients, attendances and radiation workers
- Regular supervision of the radiation workers as to ensure safe usages of radioactive materials and continuous training of radioactive material handling
- Supervision on radiation workers to ensure the proper usage of TLD badges, if need, then provide and also maintain the data of absorbed doses of the radiation workers
- Conduct regularly radioactive waste management activities
- Preparation of radiation safety protocols, such as, radiation waste management, emergency preparedness protocol, etc.
- Conduct all works related to the licensing of the institute to handle safe use of radioactive material and radiation safety
- Supervised all routine Nuclear Medicine Procedures at NINMAS, Dhaka

12. Service Rendered and Revenue Income

Name of service	No. of patient/sample	Revenue income
Number of Patients	64,333	9,58,36, 231/14
Blood Samples Analysis	26,025	
Newborn Screening: Sample	1,01,223	

INSTITUTE OF NUCLEAR MEDICINE AND **ALLIED SCIENCES (INMAS), DHAKA**

Introduction

Institute of Nuclear Medicine & Allied sciences is one of the oldest nuclear medicine in this country & it was established in 1961 in the Dhaka Medical College premises. At present this institute included different technologies like PET-CT, SPECT CT, Dual Headed Gamma Camera, BMD, Thyroid scanner and 2D & 3D Ultrasound machine. Significant numbers of patients' health care services are offered from this institute as regular basis. Objective: To render specialized medical services by using nuclear technology and conduct academic & research activities.

Activities

1. Research and Development Work(s)

To provide the attachment training to the post graduate medical students in their MD, MS residency programme and also conducted M.Sc thesis work for different universities

2. Academic

- Scheduled lectures were delivered routinely for post graduate (MD/MS) students of different disciplines of BSMMU, DMCH, NICRH, NICHD and students were placed for 15-30 days
- Taken classes to medical students (under & post-graduates) and trainees, given demonstrations to medical students (under & post-graduates) and trainees, Attended scientific seminars & workshops, Helped in student co-ordination.
- Hands on Training on different Nuclear Medicine procedures for Technologists
- Clinical rotational training for postgraduate students of different disciplines (MD/MS) under BSMMU
- Clinical rotation for undergraduate students of Dhaka Medical College

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

Name of the Participant	Title of the event	Organizer	Date	Place
Prof. J. a. Haque, Prof. Dr. F. S. Haque, Prof. Dr. S. Biswas, Prof. M. S. Reza, Prof. R. Begum, Dr. F. Rahman, Engr. M. Rahman, Dr. R. Afrin, Dr. S. Hossain, Dr. M. Hossain, Dr. M. R. Mozumder, Dr. A. Akhter, Dr. S. Sharmin, Dr. T. Biswas, Dr. T. Sultana and Dr. S. Islam	Workshop on CT, SPECT-CT, SPECT & Ultrasound Machine	Project- Enhance capacity of INMAS's at Dhaka, Chattogram, Rajshahi, Khulna, Sylhet, Dinajpur, Rangpur	20 -24 Jul. 2021	INMAS, DMCH
	PSMA for diagnosis & treatment of Ca prostate-an update on	ANMB	28 Aug. 2021	Virtual Webinar
	Use of PET-CT in PET-CT in oncology including the FDG and non FDG imaging of PSMA and DOTA TATE	IAEA	27-30 Sept. 2021	Virtual Workshop
	33rd national conference of Bangladesh society of Ultrasonography	BSU	8 Oct. 2021	Virtual Conference
	Nuclear Medicine-tricks of the trade	ANMB	18 Dec. 2021	Virtual Webinar
	Role of PET-CT for evaluating therapeutic response in Lymphoma	Society of Nuclear Medicine Bangladesh	1 Apr. 2022	SNMB Virtual Platform
	Application of Sodium Fluoride (^{18}F-NaF) PET/CT: oncology & non-oncological indications	ANMB	18 Dec. 2021	Virtual Webinar
	25th National Conference of Society of Nuclear Medicine, Bangladesh	Society of Nuclear Medicine, Bangladesh (SNMB)	20 May 2022	BICC, Dhaka
Dr. R. Afrin, Dr. A. Akhter, Dr. S. Sharmin, Dr. S. Islam and Dr. S. Biswas	Therapeutic Nuclear Medicine	Bangladesh Society of Nuclear Medicine	2 Jul. 2021	Virtual Webinar
Dr S. Biswas	Scrotal ultrasound workshop	Bangladesh Society of Ultrasound	7 Jul. 2021.	Virtual Webinar
Dr. R. Afrin, Dr. A. Akhter and Dr. S. Sharmin	Cyber summit: integrating AI & cybersecurity to your everyday radiology workflow	Singapore congress of radiology & workshops in interventional Radiology education	11 Aug. 2021	Virtual Webinar
	WIRES workshop: Angio CT	Singapore congress of radiology & workshops in interventional Radiology education	11 Aug. 2021	Virtual Webinar

Name of the Participant	Title of the event	Organizer	Date	Place
Dr S. Biswas, Dr. R. Afrin, Dr. A. Akhter, Dr. S. Sharmin and Dr. S. Islam	Singapore congress of radiology & workshops in interventional Radiology education (WIRES) in conjunction with 8th Asian congress of abdominal radiology	Singapore congress of radiology & workshops in interventional Radiology education	13 -15 Aug. 2021	Virtual
Dr. A. Akter	19th annual conference of Association of Nuclear Medicine Physicians of India	ANMPICON	18 -19 Sept. 2021	Virtual Conference
Dr. S. Sharmin and Dr. A. Akter	Emirates international conference in Nuclear Medicine, Molecular imaging &Theranostics	Dubai Health Authority	24 -25 Sept. 2021	Virtual
Prof. J. A. Haque, Dr. S. Biswas and Dr. S. Sharmin	20th Annual general meeting of the Asian Regional Cooperative Council for Nuclear Medicine	ARCCNM	1 -3 Nov. 2021.	Virtual Congress
Dr. S. Biswas, Dr. R. Afrin, Dr. A. Akhter, Dr. S. Sharmin and Dr. S. Islam	Nuclear Medicine Update 2021: 2nd PET/CT virtual workshop	Society of Nuclear Medicine, Singapore	6 -7 Nov. 2021	Virtual Webinar
Dr. R. Afrin, Dr. A. Akhter, Dr. S. Sharmin and Dr. S. Islam	Technologist update: PET/CT oncology workshop	Society of Nuclear Medicine, Singapore	9 -11 Nov. 2021	Virtual Webinar
Prof. J. A. Haque, Dr. S. Biswas, Dr. R. Afrin, Dr. A. Akhter and Dr. S. Sharmin	16th international conference on Radiopharmaceutical Therapy	WARMTH	4 -5 Dec. 2021	Virtual
Dr. S. Sharmin, Dr. A. Akhter Dr. S. Islam	53rd annual conference of Society of Nuclear Medicine, India	Society of Nuclear Medicine, India (SNMICON,2021)	16 -18 Dec. 2021	Virtual Webinar
Dr. S. K. Biswas and Dr. S. Hossain	1st National NCDs Conference Bangladesh	Bangladesh Non-Communicable Diseases Forum (BNCDF)	26-28 Jan. 2022	Pan Pacific Sonargaon Hotel
Dr. S. Sharmin, Dr. A. Akhter and Dr. S. Islam	26th annual conference society of Nuclear Medicine, southern chapter	Society of Nuclear Medicine, India Southern chapter.	5-6 Feb. 2022	Virtual
Dr. S. Biswas and Dr. A. Akhter	IPDI Cardiocon 2022	Integrated Professional Development Initiative (IPDI) Forum	17-18 Mar. 2022	Pan Pacific Sonargaon

Name of the Participant	Title of the event	Organizer	Date	Place
Dr. S. Sharmin and Dr. A. Akhter	Middle East and North Africa First Thyroid Cancer Symposium Mena-TCS-2022.	Jordanian Medical Council	31 Mar. 2022	Virtual Webinar
Dr. S. Biswas, Dr. R. Afrin, Dr. A. Akhter and Dr. S. Sharmin	On demand: Nuclear cardiology around the world: A patient first approach- Asia-Pacific/Oceania	American society of Nuclear Cardiology (ASNC)	4 Jun. 2022	Virtual Webinar
Dr. S. Biswas, Dr. S. Biswas, Dr. R. Afrin, Dr. A. Akhter and Dr. S. Sharmin	SNMMI Annual Meeting, 2022	Society of Nuclear Medicine & Molecular Imaging	11-14Jun. 2022	Virtual Webinar
Prof. J. A. Haque, Prof. R. Begum, Dr. F. Rahman, Dr. R. Afrin, Dr. M. Hossain, Dr. A. Akhter, Dr. S. Sharmin, Dr. T. Biswas, Dr. T. Sultana and Dr. S. Islam	5thNational conference of Bangladesh Thyroid Society	Bangladesh Thyroid Society. (BTS)	17 Jun. 2022	Pan pacific Sonargaon Hotel

4. Manpower Development and Training Programme

Name of the participant	Title of the event	Organizer	Date	Place
Dr. S. K.Biswas	Conduct & Discipline	Bangladesh Public Administration & Training Centre, Savar	7 -11 Nov 2021	Regional PATC, New Eskaton, Dhaka
Dr. S. Hossain	e-Governance & Innovation in Public Service	Bangladesh Atomic Energy Commission	26 May 2022	BAEC HQ
Md. A. Rahman	Financial Management Course	Bangladesh Public Administration & Training Centre, Savar	19-30 Dec. 2021	Regional PATC, New Eskaton, Dhaka
S. Khatun	Information & Communication Technology Course	Bangladesh Public Administration & Training Centre, Savar	29 May-9 Jun. 2022	Regional PATC, New Eskaton, Dhaka
A. B. Siddique	General Behavior and Office Rules	BAEC, Dhaka	21-23 Jun. 2022	TI, AERE
M. A. Rahman	General Behavior and Office Rules	BAEC, Dhaka	21-23 Jun. 2022	TI, AERE

Name of the participant	Title of the event	Organizer	Date	Place
M. A. K. Azad	General Behavior and Office Rules	BAEC, Dhaka	21-23 Jun. 2022	TI, AERE
B. C. Biswas	e-Governance & Innovation in Public Service	Bangladesh Atomic Energy Commission	26 Jun. 2022	BAEC HQ

5. Arranged Training

Arranged workshop on clinical operational training on CT, SPECT-CT, SPECT & Ultrasound, at INMAS, DMCH on 20 -24 Jul. 2021.

6. Collaboration Work/MoU

IAEA RCA Project: NPC of RAS 6101, improving the quality and safety of Radiation Medicine through Medical Physicist Education and Training

7. Lecture Delivered

Name of the Lecturer (s)	Title of the event	Organizer	Date	Place
Dr. S. K. Biswas	Scrotal Ultrasound Workshop	Bangladesh Society of Ultrasonography	7 Jul. 2021	Virtual Platform
	State of the Art Nuclear Medicine & Imaging Procedures	Department of Nuclear Engineering, DU	31 Aug. 2021	DU (virtual)
	MPI: Basic & Clinical Implication	IPDI Virtual Classroom for Cardiology post graduate fellows	26 Feb. 2022	NICVD/IPDI (Virtual)
	Role of PET-CT for evaluating therapeutic response in Lymphoma	Society of Nuclear Medicine Bangladesh	1 Apr. 2022	Virtual Platform
Dr. R. Afrin	BSRI Webinar Series	BSRI	9 Jul. 2021	BSRI (Virtual)
	Current Trend in Safety practice in Radiology	Asia Oceanian Society of Radiology	6 Apr. 2022	AOSR (Virtual)

8. Extracurricular

- M. S. Reza is servine as RCO
- Dr. R. Afrin is serving as a member in QSS (Quality, safety & Standard) committee of Asia Oceanian Society of Radiology (AOSR) and is serving as a member in Asia Safe
- Dr. A. Akhter is serving as a member of Quick Response team of COVID-19 management

9. Others

- Carcinoma Breast: Sentinel lymph node detection& role of SPECT-CT
- Rest only gated MPI & cardiac gated PET before revascularization and its correction with functional recovery following acute myocardial infarction (AMI).
- Evaluating carcinoma of unknown primary (CUP) & role of PET-CT
- Primary lung cancer: PET & CT and genetic analysis for predicting outcome of patients

10. Service Rendered and Revenue Income

Name of service	No. of patient/sample	Revenue income
Sample analysis (including blood sample) Regular Patient Service	53333	5,17,35,480/-
Total		5,17,35,480/-

INSTITUTE OF NUCLEAR MEDICINE AND 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, Renal scan (DTPA, DMSA), HIDA scan, Hepatobiliary scan,Thyroid scan and Parathyroid scan, Lymphoscintigraphy
- All sort of diagnostic USG including normal B-Scan of different organ, HRUS of superficial organs
- Duplex study of vascular system
- In Vitro diagnostic services includes hormone analysis like T_3, T_4, FT_3, FT_4, TSH, FSH, LH Prolactine, Testosterone, Eestrogen, Progesterone. Different types of thyroid antibody and tumor marker; i.e.Tg are routinely performed in this institute

1.2 Therapeutic service

- Therapeutic activities include radioiodine therapy of thyroid cancer and hyperthyroid patients

2. Research and Development Work(s)

- Role of USG in Benign Thyroid disease
- Ectopic thyroid & other miscellaneous
- Effects of radioiodine treatment on salivary gland function in patients with differentiated thyroid carcinoma: experience at INMAS, Mitford
- Experience of Bone scan in carcinoma breast patients with metastases in different organ- Single institute based study
- Patterns of 99m-TcDTPA Renogram findings in symptomatic patients with Horseshoe- kidney: observation of a single Center"

3. Manpower Development and Training Programme

Title of event	Date	Place	No of participant
APAMS software training on Zoom Platform	30 Dec. 2021	Zoom Platform	1
চাকুরীর আচরণ বিধি ও নিয়ম-শঙ্খলা সংক্রান্ত প্রশিক্ষন	20 -22 Jun. 2022	Savar	1
Basic Computer operation system (MS word, MS excel, Power Point)	28 Sept. 2021	INMAS, Mitford	7
অগ্নি নিরাপত্তা সচেতনার লক্ষ্যে হাতে-কলমে প্রশিক্ষন	31 Jan. 2022	INMAS Mitford	4

Basic Operation of Electrical and electronic Equipments	23 Dec. 2021	INMAS Mitford	7
Basic quality control check-up of gamma camera	27 April 2022	INMAS Mitford	6
ই- গভন্যান্স ও নাগরিক সেবায় উদ্ভোবন	26 Jun. 2022	BAEC, Dhaka	1

4. Seminar/Conference/Workshop/Meeting Attended

Name of the participant	Title of the event	Organizer	Date	Place
Dr. H. A. Rahman, Dr. J. Hossain, Dr. S. Sharmin, Dr. S. Salekin, Dr. A. Naznin and Dr. N. Islam	25th SNMB conference.	SNMB	20 May 2022	Dhaka (Virtual)
Dr. H. A. Rahman, Dr. S. Sharmin and Dr. A. Naznin	26 WFUMB center of Education Workshop	BSU	4-5 Mar. 2022	Dhaka (Virtual)
Dr. H. A. Rahman	জাতীয় শুদ্ধাচার ও সু-শাসন	BIM	22 Jan. 2022	Dhaka (Virtual)
	ARCCNM Virtual Conference 2021	ARCCNM	1-3 Nov. 2021	BAEC, Dhaka
	৪র্থ শিল্প বিপ্লবের চ্যালেন্জ মোকাবেলায় করণীয় বিষয়ে অবহিতকরণ	BAEC	14 Jun. 2022	Dhaka
Dr. Afroza Naznin	ই- গভন্যান্স নাগরিক সেবায় উদ্ভোবন	BAEC, Dhaka	31 Jan. 2022	BAEC, Dhaka
	5th National conference and Annual General Meeting	BTS	17 Jun.2022	Dhaka
Dr. H. A. Rahman, Dr. J. Hossain, Dr. S. Sharmin, Dr. A. Naznin and Dr. N. Islam	33th Natioanl Conference of The Bangladesh Society of Ultrasonography	BSU	8 Oct. 2021	Dhaka (Virtual)
Dr. S. Sharmin	Training on High End Premium level 4D color Doppler Machine	-	20-29 Dec. 2021	NOIDA India
B.K. Paul	Clinical Training on SPECT and SPECT/CT	-	23-27 May 2022	Hungary
	তথ্য অধিকার, অভিযোগ প্রতিকার ব্যবস্থা ও জি আর এস সফটওয়্যার, সেবা প্রদান প্রতিশ্রুতি বিষয়ক প্রশিক্ষন	BAEC	6 Jun. 2022	Dhaka

5. Stakeholder meeting

- জাতীয় শুদ্ধাচার কোশল কম পরিকল্পনা ২০২১-২২ এর সূচক মোতাবেক গণশুনানী আয়োজন, ইনমাস, মিটর্ফোড , ৭ই এপ্রিল ২০২২
- সেবা গ্রহীতাদের অভিযোগ বিষয়ে মত বিনিময় সভা, ইনমাস, মিটর্ফোড , ১৩ ডিসেম্বর ২০২১

6. Others

- Scheduled Lectures were delivered to M.Phil/ MD/ MS students of different discipline of SSMCH, Mitford
- Scheduled Lectures were delivered to MD (Nuclear Medicine) students
- Monthly in-house meeting and Seminar is held regularly

7. Service Rendered and Revenue Income

Name of service	No. of patient	Revenue income
Scintigraphy service	1666	1,54,14,800 / -
Blood sample analysis	10926	
I^{131} Therapy	51	
USG and others	14379	
Total	27,022	1,54,14,800 / -

INSTITUTE OF NUCLEAR MEDICINE AND ALLIED SCIENCES (INMAS), CHATTOGRAM

Objective/Introduction

Institute of Nuclear Medicine & Allied Sciences, Chattogram is one of the oldest Nuclear Medicine Institute in Bangladesh and was established in 1970. With the vision to render specialized medical services to the people using nuclear technology for peaceful uses of atomic energy to achieve self-reliance for overall socio-economic development. This institute is presently functioning with facilities like Dual Head & Single Head SPECT Gamma Camera, SPECT-CT, CT Scanner, Thyroid Scanner, Ultrasonogram, Colour Doppler and In-Vitro & Hormone Laboratory for Radioimmunoassay (RIA) with Computerized Gamma Well Counter and other necessary facilities.

Activities

1. Patient Services

1.1 Radionuclide Imaging

Bone Scan, Renogram, Renal Scan, Thyroid Scan, Liver Scan, RBC 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, Estradiol, AFP and Cortisoletc.

1.4 Ultrasound

- General Ultrasound (Whole Abdomen, Lower/Upper Abdomen, Pregnancy profile, HBS, KUB etc.)
- High Resolution 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 Programme

Title of the event	Date	Place	No. of participant
Training on Thyroid & Breast HRUS Examination & Reporting System	10-11 Oct. 2021	INMAS, CTG	3
Capacity Development for Managing Public Procurement Processes	22- 25 Oct. 2021	INMAS, CTG.	1

Research Methodology (Zoom Online)	27 Aug. - 6 Sept. 2021	INMAS, CTG.	1
Quality Assurance in Radiotherapy and Diagnostic Radiology: Involvement of Stakeholder	11 Nov. 2021	INMAS, CTG.	5
Training on APAMS Software	30 Dec. 2021	INMAS, Ctg.	3
Training on National Integrity & Good Government	22 Jan. 2022	INMAS, Ctg.	1
Training on Use Rules of TC-^{99m} Generator & I-^{131} Isotope	22 Feb. 2022	INMAS, Ctg.	6
Workshop on Contemporary Issues Related of LDG Implementation	8 Mar. 2022	INMAS, Ctg. (Zoom Online)	2
Training on right to Information &Complaint Remedy& GRS Software	19 Apr. 2022	INMAS, Ctg. (Zoom Online)	2
Application Training on Dual HeadSPECT-CT	8 - 12 May 2022	INMAS, Ctg.	6
Application Training on Dual Head SPECT-CT	13-17 17 May 2022	INMAS, Khulna	2

3. Others

Twenty five students of Chattogram Poly Technique Institute successfully completed the three months training programme on Nuclear Medicine Instrumentations under our guidance.

4. Service Rendered and Revenue Income

Name of service	No. of patient	Revenue income
Patient Service	22,750	1,89,68,220/-
Sample Analysis (including blood sample)	31,325	2,00,65,250/-
Total	54,075	3,90,33,470/-

INSTITUTE OF NUCLEAR MEDICINE AND ALLIED SCIENCES (INMAS), MYMENSINGH

Introduction

Institute of Nuclear Medicine and Allied Sciences (INMAS), Mymensingh as an organization of Bangladesh Atomic Energy Commission is committed to peaceful use of Atomic Energy in the field of medicine. INMAS, Mymensingh has been started its work in 1989 using Nuclear technology in the Department of Radiology of MMCH occupying 3 rooms only naming as Nuclear Medicine Centre. At present it stands in its own 3 storied building in the north-east corner of MMCH. All the major Nuclear Medicine investigations and Ultrasound imaging are done in this Institute. This Institute offer Nuclear Medicine therapy services in hyperthyroidism and thyroid cancer. All the investigations and therapy offered by the Institute in a subsidized cost as determined by the commission and adjusted time to time. This Institute is also a hub of radioimmunoassay performing about 26 types of hormone & cancer marker studies. A host of senior & junior qualified & skilled Doctors and technologists are working in this Institute. They are all dedicated to offer best therapeutic & investigation skill to the service of humanity. Recently the Institute is going to equip with the prestigious Nuclear Medicine PET-CT facilities which is a very useful nuclear technology for diagnosis and staging of cancer patients.

Objective

- To provide specialized medical services to the people using nuclear and high quality ultrasound technology
- To improve and upgrade Nuclear Medicine facilities in the country
- To build up skilled nuclear medicine physicians, physicists and technologists through academic & specialized training

Activities

1. Research and Development work(s)

The Association of Thyroid Scintigraphy with Autoimmune Thyroiditis in Women of Child Bearing Age

S. Z. Rima, N. Khan, F. A. Dowel, R. Ara, N. Nahar, N. Zaman and R. K. Chakraborty

The objective of the study is to evaluate the scintigraphic features of thyroid gland & to determine its association with autoimmune thyroiditis in women of child bearing age. In this study, 100 women of child

bearing age (15-45 Yrs) with any sorts of suspected thyroid disorders are included. HRUS has been taken as the principal modality for the diagnosis of autoimmune thyroiditis. T3, T4 and TSH are taken as an important indicator for thyroid function status. Thyroid Microsomal Antibody (Anti-TPO) level is measured to see the thyroid antibody status. Thyroid scintigraphy with Tc-99m pertechnetate has performed in all cases to evaluate the scintigraphic features. In this study, according to the diagnosis based on HRUS findings, the patients are categorized as AIT and Non-AIT. Forty one percent women are diagnosed as AIT and 59% are diagnosed as Non-AIT patients. Among the 41 AIT patients, FNAC has done in 27 patients and 25 patients are confirmed cytologically which is statistically significant. Thyroid scintigraphy in AIT patients showed increased radiotracer concentration in 35(94.6%) cases, decreased radiotracer concentration in 1(2.7%) cases and 1(2.7%) case showed irregular radiotracer concentration. Considering the radionuclide thyroid scan findings, increased radiotracer concentration is seen in 35(36.46%) AIT patients and in 6 (6.25%) non-AIT patients. Chi-square test demonstrated a significant association of AIT with the increased radiotracer concentration in thyroid scintigraphy. The scintigraphic findings can play a complementary role along with thyroid functional status in differentiating autoimmune thyroiditis from other thyroid diseases, thereby influencing treatment.

2. Manpower Development/Training Programme

Title of the event	Date	Place	No. of participant
In-house training decorum of office staff on Covid-19 situation as Corona Preparedness protocol	1 Jul. 2021	INMAS, Mymensingh	49
Seminar on Fetal Doppler Evaluation with Emphasis on FGR	16 Aug. 2021	INMAS, Mymensingh	7
Fetal middle cerebral to uterine artery pulsetility index radios in normal and pre-eclamptic pregnancies	13 Sept. 2021	INMAS, Mymensingh	6
Workshop on Radiation protection in nuclear medicine	27 Nov. 2021	INMAS, Mymensingh	21
Concentration of thyroid hormones in blood serum by chemiluminescence immunoassay	17 Feb. 2022	INMAS, Mymensingh	17
Seminar on Adenosine stress MPS in comparison to echocardiography	8 Mat. 2022	INMAS, Mymensingh	12
Training course on "Radiation protection for radiation workers and RCOs of BAEC medical facilities & industries"	24-28 Oct. 2021	TI, AERE	1
Learning session/workshop on "Sustainable development goals (SDG)"	8 Mar. 2022	Virtual meeting, Dhaka	5
Operational Training of Thyroid Gamma Camera in Hungary under the "Establishment of Cyclotron and PET-CT facilities at INMAS Chattagram & Mymensingh and Cyclotron facilities at INMP Savar" project	23-27 May2022	Hungary	1
Training on e-Nothi	12-16 Jun. 2022	RPATC, Dhaka	1
In-house training on Annual performance agreement (APA)	22 Jun. 2022	Virtual meeting	8
Operational Training of Bone Mineral Densitometry (BMD) in France under the "Establishment of Cyclotron and PET-CT facilities at INMAS Chattagram & Mymensingh and Cyclotron facilities at INMP Savar" project	2-8 Jun. 2022	France	1
Training on "General Behavior and office Rules"	21-23 Jun. 2022	TI, AERE	2

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

Name of the participant	Title of the event	Organizer	Date	Place
Prof. Dr. M. N. Khan, Prof. Dr. R. K. Chacraborty, Dr. S. Z. Rima, Dr. M. Nadiruzzaman, Dr. N. N. Shapla, Dr. R. A. Ruma and Dr. F. A. Dowel	33rd National conference and annual general meeting of Bangladesh Society of Ultrasonography (BSU)	BSU	8 Oct. 2021	Dhaka (Virtual)
	26 WFUMB COE Workshop	BSU	4-5 Mar. 2022	Dhaka (Virtual)
Prof. Dr. M. N. Khan, Prof. Dr. R. K. Chacraborty, Dr. S. Z. Rima, Dr. N. N. Shapla, Dr. R. A. Ruma, Dr. F. A. Dowel, M. A. Karim and M. J. Ahmed	25th Silver Jubilee National Conference of SNMB	SNMB	20 May 2022	BICC, Dhaka
Prof. Dr. M. N. Khan, Dr. M. Nadiruzzaman, Dr. S. Z. Rima, Dr. F. A. Dowel, M. A. Karim and M. Asaduzzaman	5th Annual National Conference and Scientific Meeting of BTS	BTS	17 Jun. 2022	PAN Pacific Sonargaon Hotel, Dhaka

4. Collaboration Work(s)

IAEA RCA Project (RAS 6079), Strengthening Hybrid Imaging in Nuclear Medicine in Asia.

5. **Repair, Maintenance and Renovation works**

- Regular Maintenance of 60 KVA UPS in SPCET/CT Room, 3KVA UPS in BMD and Ultrasound Machine rooms
- Regular Maintenance of 45 KVA Perkins GPR50 Generator System
- Regular Maintenance of Air Condition System (AC)
- MDB Board Replacement by New ones
- Renovation Work of the MDB Board to Sub- MDB Board Cable System
- Maintenance of Ultrasound Machine, Problem in Accuvix A30 repaired by respective engineer
- Regular practicing of QC programme of Nuclear Medicine Instruments and assisted in repair and maintenance
- Renovation of a dedicated room for breast-feeding mothers in the institute

6. Lecture Delivered

- Series of lectures were arranged on SPECT-CT for doctors, scientist & scientific staff of INMAS, Mymensingh
- Series of lectures on radiation control and safety were held on during this period for scientific staffs of INMAS, Mymensingh
- Scheduled lectures were delivered routine to Postgraduate students of different disciplines (MD, MS, DEM) of MMCH and students placed for Practical demonstration
- Weekly journal meeting as continuous education programme conducted on resent Nuclear Medicine and Allied science related works regularly in this institute
- Participation in weekly clinical meeting and journal club arranged by MMCH & MMC where highlighted Nuclear Medicine and Allied Science related facilities

7. Others

- The Institute provides research facility for post graduate students of MD, MS, M Phil & PhD programme of different institutes such as MMC
- Radioimmunoassay laboratory provide services to different research programmes of different discipline of medical sciences

- This Institute provides facility to perform research programme in association with other institutes such as MMC & BAU, Mymensingh
- All the necessary informations are provided in Institute's own website www.inmasmym.org

8. Service Rendered and Revenue Income

Name of service	No. of patient	Revenue income
Sample analysis (including blood sample)	47766	36528470/-
Ultrasound including Doppler investigation service	19967	8745870/-
Nuclear investigation service	3188	4170600/-
Patient service including Radioiodine therapy & Follow-up	763	152600/-
Total	71684	4,95,97,540/-

INSTITUTE OF NUCLEAR MEDICINE AND 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
- All 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) & CT-Scan are 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. Manpower Development/Training Programme

Title of the event	Date	Place	No. of participant
Integrity & E-Nothi Training	28 Sept. 2021	INMAS, Sylhet	21
Medical equipment Maintenance & Etiquette	11 Oct. 2021	INMAS, Sylhet	21
Etiquette & etiquette	13 May 2022	INMAS, Sylhet	21
Bangladesh Secretariat Guidelines 2014	15 Dec. 2021	INMAS, Sylhet	21
Office Equipment Maintenance	14 Feb. 2022	INMAS, Sylhet	17
Different Type of holidays	14 Mar. 2022	INMAS, Sylhet	21
Holy-day Rules -1959, Financial Management	7 Apr. 2022	INMAS, Sylhet	19
Improvement of Office Management & Work Environment	31 May 2022	INMAS, Sylhet	21
Promises of service	23 Jun. 2022	INMAS, Sylhet	20

3. Academic

Scientific Training of 24 Post graduate students of different faculties regarding Nuclear Medicine.

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

Name of the participant	Title of the event	Organizer	Date	Place
B. Debnath	Training Course on Radiation Protection for Radiation Worker's RCO's of BAEC	TI, AERE	24-28 Oct. 2021	AERE
Dr. K. Nahar	APAMS Software Training	BAEC	30 Dec. 2021	Zoom platform
	National Virtuousness & Rules	BIM, Dhaka	22 Jan. 2022	Zoom platform
	Women in Leadership	BIM, Dhaka	23-24 Feb. 2022	Dhaka
	Operational and Clinical Training on Dual SPECT-CT	Project	8-21 May 2022	Germany
Dr. K. Nahar and Dr. M. M. A. Z. Bhuiyan	SDG Implementation	BAEC	8 Mar. 2022	Zoom platform
	Dual Head SPECT-CT25th National Conference & Annual General Meeting	Bangladesh Thyroid Society	22-17 Jun. 2022	Hotel Sonargoen Dhaka
Dr. K. Nahar and Dr.A. Mia	Right to information and grievance redressal System	BAEC	19 Apr. 2022	Zoom platform
Dr. M. M. A. Z. Bhuiyan and Dr. A. Sultana	25th jubilee National Conference	SNMB	20 Apr. 2022	BICC, Dhaka
Dr. M. S. Munir	Operational, Clinical and Service Training on	Project director	21-29 May 2022	Hungary
Dr. A. Mia	Clinical Training on Dual Head SPECT-CT	Project director	5-19 Jun. 2022	Germany
H. C. Das	Rules and regulations of service Conduct	TI, AERE	20-22 Jun. 2022	AERE

5. Service Rendered and Revenue Income

Name of service	Number of patient	Revenue income
Patient Service	23962	1,48,40,800/-
Sample Analysis (including blood sample)	13,229	

INSTITUTE OF NUCLEAR MEDICINE AND ALLIED SCIENCES (INMAS), RAJSHAHI

Objective/Introduction

Institute of Nuclear Medicine & Allied Sciences (INMAS), Rajshahi is located at North West part of the Bangladesh. This Institute provides services to the people of greater Rajshahi and nearby districts using nuclear technology and Ultrasonography and is making a great impact in this region for betterment of health services.

Activities

1. Manpower Development and Training Programme

Title of the event	Date	Place	No. of participant
In-Plant Training of 4th year students of Bio-Chemistry and Molecular biology, RU	20-30 Dec. 2021	INMAS, Rajshahi	8

QA in Radiotherapy and Diagnostic Radiology	16 Jan. 2022	INMAS, Rajshahi	40
MD (Oncology) Residency course training	7-13 Mar. 2022	INMAS, Rajshahi	4
Training on Medical Technology (B. Sc), IHT, Rajshahi	24 Mar - 6 Apr. 2022	INMAS, Rajshahi	17
Training on Medical Technology (Diploma), IHT, Rajshahi	28 Mar. - 2 Apr. 2022, 29 Apr. - 5 May 2022, 31 May - 6 Jun. 2022	INMAS, Rajshahi	28
Training on Medical Technology (Diploma), IHT, Shirajgang	23 Apr.-7 May 2022	INMAS, Rajshahi	9
Training on Medical Technology (Diploma), IHT, Shathkira	29 May-7 Jun. 2022	INMAS, Rajshahi	1
MS (General Surgery) Residency course training	13-27 Jun. 2022	INMAS, Rajshahi	4

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

Name of the participant	Title of the event	Organizer	Date	Place
All Doctor(s)	webinar on "Therapeutic Nuclear Medicine"	SNMB	2 Jul. 21	Dhaka
M. S. I. Chowdhury	webinar on "Medical physics: Education, research and Profession of Clinical Importance	Bangladesh Medical Physics Association	17 Sept. 21	Dhaka
Dr. M. S. Ahsan and M. S. I. Chowdhury	On line Workshop on SDG	BAEC	2 Mar. 22	BAEC, Dhaka
All Doctor(s)	Webinar on PET-CT in Lymphoma	SNMB & GE Health Care	1 Apr. 22	Dhaka
M. J. Alam and M. S. I. Chowdhury	On-line training on Right to Information	BAEC	19 Apr. 22	BAEC, Dhaka
Dr. M. S. Ahsan, Dr. N. begum, Dr. M. Hossain, Dr. T. A. Synthi, Dr. S. N. Alam and M. S. I. Chowdhury	25th National Conference of SNMB	SNMB	20 May 22	BICC, Dhaka
M. J. A. Khan and M. A. Hossain	Training on RIA	NINMAS	28-29 Jun. 22	NINMAS, Dhaka
Dr. M. S. Ahsan, Dr. N. begum, Dr.S. N. Alam, Dr. S. Mahmud, Dr. F. U. Ahmed and Dr. T. Ahmed	5 th Nation Conference and General Meeting	Bangladesh Thyroid Society	17 Jun. 22	P P Sonargaon , Dhaka

3. Service Rendered and Revenue Inccome

Name of service	No. of patient	Revenue income
Patient service	44427	3,38,87,100/-
Sample Analysis (blood)	52209	
Total		3,38,87,100/-

INSTITUTE OF NUCLEAR MEDICINE AND 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 adition to toxic patient treatment. Thyroid disease related research activities also done in this institute for the last decades.

Activities

1. Services

1.1 Diagnostic

1.1.1 In-vivo Technique

- Thyroid Scan: This test is performed with thyroid scanner to determine the function of thyroid gland.
- Nuclear Imaging: Diseases of bone, brain, liver, kidney, thyroid gland etc. are detected by taking images of the respective organs with Dual Head SPECT.
- BMD: Bone Mineral Densitometry (BMD) is used to assess bone mineral content of the patient for detection of osteoporosis and osteopenia.
- Renogram: This test is performed with SPECT machine to determine the functional status of kidneys.
- SPECT-CT: a) HRCT-Chest, CT-Abdomen with or without contrast, CT-Brain, CT-Orbit, Paranasal sinus, cervival spine, Mastoid bones routinely done. b) Fusion image (SPECT-CT) also performed here.

1.1.2 In-vitro Technique

Thyroid related hormones (T_3, T_4, TSH, FT_3, FT_4, Tg and Antithyroid Antibody, serum D3, tumor marker) are being estimated in the lab by Radio Immunoassay (RIA) technique and CLIA method.

1.1.3 Ultrasonogram with Color Doppler

Ultrasonogram both conventional and color doppler ultrasound available here. In addition with routine USG, Foetal anomaly Scan, NT-Scan routinely performed here.

1.2 Therapeutic

- Radioactive Iodine (I-131) is used for treatment of thyrotoxicosis and thyroid cancer patient.

2. Research and Development Work(s)

Application of Nuclear Medicine technique in the diagnosis of Thyroid disorder was established in INMAS, Dinajpur since 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 scintigraphy, RIA and IRMA for hormonal assay are regularly performed procedures in our institute. Recently we also doing Thyroid hormone assay and different cancer marker assay, serum D3 level by our recently siemens machine with CLIA Methods. We evaluate different Thyroid disorder and treat toxic goiter and Thyroid cancer patients. A 06 (six) stored new building was established by a project named "Enhancing Capacity of INMAS at Dhaka, Chittagong, Khulna, Sylhet, Rajshahi, Dinajpur and Rangpur" With this project, SPECT-CT Machine, DUAL Head SPECT, CLIA and colour Doppler Ultrasonography Machine was introduce, We are doing different types of Nuclear Medicine imaging like Bone scan, Renogram, Renal Scan by SPECT Machine and CT San of Chest, Abdomen, Brain, orbit by our recently establishied SPECT-CT Machine, Since its establishment in month of Nov. 2020, We performed HRCT-chest of Covid-19 affeeted patient. In addition to performing routine Ultrasonography, We are also doing Fetal Anomally Scan, NT-Scan in our obstetrics USG department. We also started SPECT-CT Scan (Fusion image) recently with the newly established Dual Head SPECT. In our In-vitro Lab we are performing different Thyroid hormoe assay, serum D3 assay and Tumor marker assay by RIA and CLIA method.

2. Repair, Maintenance and Renovation Works

Under the project of "Enhancing Capacity of INMAS at Dhaka, Chattogram, Khulna, Sylhet, Rajshahi, Dinajpur and Rangpur" renovation works done. Thyroid Uptake System, BMD Machine, Color Doppler Ultrasonography, Dual Head SPECT, Dual Head SPECT-CT Machine installed in the institute by this project.

3. Manpower Development and Training Programme

Title of the event	Date	Place	No. of participant
Inhouse Training on Colour Doppler Ultrasonography	22-31 May 2022	INMAS, Dhaka	1
Operational and Clinical Training on Dual Head SPECT-CT	22 May - 4 Jun. 2022	Germany	1
National Conference & Scientific Meeting of Society of Nuclear Medicine Bangladesh (SNMB)	25 May 2022	BICC, Dhaka.	4
5th National Conference & Scientific Meeting of Bangladesh Thyroid Society	17 Jun. 2022	Sonargaon Hotel, Dhaka.	1
Training on Service code of conduct and rules and regulation of staff	21-23 Jun. 2022	TI, AERE	2

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

Name of the participant	Title of the event	Organizer	Date	Place
N. Debnath (Ad. Secretary, MOST), M. A. U. Sarder (DS, MOST), M. S. Rahman (Senior Assistant Secretary, MOST) Dr. B. K. Bose, Dr. S. Ahmed, Dr. S. Kundu, Dr. A. Begum and other Doctor & elite person of Dinajpur	Meeting on Good Govornance	Ministry of Science and Technology	13 Mar. 2022	INMAS, Dinajpur
N. Debnath (Aditional Secretary, MOST), M. A. U. Sarder (Deputy Secretary, MOST), M. S. Rahman (Senior Assistant Secretary, MOST) Dr. B. K. Bose, Dr. M. W. Haque, Dr. B. Uddin, Dr. M. F. Rahman and other Doctor & Journalists, social workers of Dinajpur	Meeting on Public awareness on write to information act.	Ministry of Science and Technology	14 Mar. 2022	INMAS, Dinajpur
	Meeting on Inform about the Services	Ministry of Science and Technology	14 Mar. 2022	

6. Stakeholder/APA/NIS Meeting

- Mr. N. Debnath, Aditional Secretary, MOST, Dhaka, 13.Mar. 2022
- M. A. U. Sarder, Deputy Secretary, MOST, Dhaka, 13.Mar. 2022
- M. S. Rahman, Senior Assistant Secretary, MOST, Dhaka, 13.Mar. 2022
- Mr. S. Choudhury, Finance Advisor, BAEC, Dhaka, 24 Oct. 2021
- Mr. S. M. N. Islam, Director, Finance and Budget Division, BAEC, Dhaka, 24 Oct. 2021
- M. M. A. Mia, Accounts Officer, Finance and Budget Branch, BAEC, Dhaka, 24 Oct. 2021
- Dr. M. K. Alam, Director, Scientific Information Division, BAEC, Dhaka, 11 Jun. 2022

6. Service Rendered and Revenue Income

Name of service provided	No. of sample/patient	Revenue income
Patient Service	2078	4,15,600/-
Sample Analysis (including blood sample)	6365	38,19,100/-
Thyroid Scan, Ultrasonography and others	3466	55,75,660/-
Total	11909	98,10,360/-

INSTITUTE OF NUCLEAR MEDICINE AND ALLIED SCIENCES (INMAS), RANGPUR

Objective/Introduction

Institute of Nuclear Medicine and Alliad Sciences, Rangpur is located in the northern part of the country in the premises of Rangpur medical College Hospital. The Institute provides diagnostic & therapeutic services to the people of Northern part of Bangladesh covering greater Rangpur, part of greater Bogra & Dinajpur using nuclear technology & ultrasound system. Since inception in 1989 the Institute made a great impact in this region for the betterment of health services.

Activities

1. Research and Development Work(s)

By using invivo & in vitro nuclear techniques & ultrasound various R & D programmes are going in relation to hypothyroidism, thyrotoxicosis thyroid cancers, renal diseases foetal maturity & hepatobiliary diseases scientific discussions on journals collected through Internet are done time to time.

2. Manpower Development and Training Programme

Title of the event	Date	Place	No. of participant
APA Tarining programme	22 Jun. 2022	INMAS, Rangpur.	17

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

Name of the participant	Title of the event	Organizer	Date	Place
Dr. M. M. Ali	Operation & Clinical Training on Dual Head SPECT-CT	SIEMENS company Ltd.	8-21 May 2022	Germany

4. Academic

- The Institute is carrying out academic activities in Collaboration with the Department 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

5. Service Rendered and Revenue Income

Name of service	No. of patient	Revenue income
Patient Service	22700	1,35,14,700/-

INSTITUTE OF NUCLEAR MEDICINE AND 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 works in the relevant fields

Activities

1. Research and Development Work(s)

- Correlation of Vitamin D, Parathyroid Hormone and Bone Mineral Density in Healthy Young adult
- Radioiodine uptake test with percentage thyroid scan uptake in Hyperthyroid patient
- Radioiodine ablation in low risk group of Thyroid Carcinoma patient

2. Manpower Development and Training Programme

Title of the event	Date	Place	No. of participant
In-house Training on Quality Management of RIA & CLIA system	23 Mar. 2022	INMAS, Khulna	07
Workshop on Fire Extinguisher Management System's	8 Feb. 2022	INMAS, Khulna	13

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

Name of the participant	Title of the event	Organizer	Date	Place
Dr. J. Das	ACR TIRADS: overview & application	BSU	8 Oct. 2021	Dhaka
	Outcome of radioiodine ablation followed by thyroid surgery in children with differentiated thyroid carcinoma	ARCCNM	1 -3 Nov. 2021	Virtual
Dr. R. Afrin, Dr. U. Islam, Dr. S. Sharmin, Prof. S. Biswas, Dr. J. Das, Dr. A. Akter, Prof. R. Begum and Prof. J. A. Haque	Detection of Mayer-Rokitansky-Kuster-Hauser Syndrome with Bilateral Renal Ectopia in A 16-Years Girls By Multi Modality Imaging	SGCRWIRES	11 - 15 Aug. 2021	Virtual
Prof. S. Biswas, Dr. R. Afrin, Dr. M. Hossain, Dr. S. Islam, Dr. S. Sarmin, Dr. J. Das, Dr. F. Rahman, Dr. S. Hossain and Dr. M. R. Majumder	Ectopic Intrathoracic Kidney in an Adult Male Detected by ^{99m}Tc DMSA Radionuclide Scan - A Rare Case Report	SGCRWIRES	11 - 15 Aug. 2021	Virtual

4. Academic

- Post-graduate students and Internee doctors of Medicine Department, Khulna Medical College received training of Thyroid disease management from Thyroid Clinic
- Arranged Seminar on Nuclear Medicine, Ultrasound procedures and related subjects monthly
- To provide six (06) months honorary training on Nuclear Medicine & Ultrasound

4. Service Renderd and Revenew Income

Name of service	No. of patient	Revenue income
Patient Service	36,958	2,47,50,490/-
Total	36,958	2,47,50,490/-

INSTITUTE OF NUCLEAR MEDICINE AND 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, BMD, thyroid uptake system and three ultrasonography machine with Colour Doppler , Elastoscan and 3D/4D facilities and a RIA Laboratory. The Institute supplies amniotic membrane for burn patients & bone chips for orthopedic injury.

Activities

1. Services

1.1 Diagnostic Activities

1.1.1 Ultrasonography and Color Doppler

Ultrasonography is the main diagnostic tool of the Institute. More than 50% of patients are handled through this system.Routine sonography of abdominal organs, HRUS of thyroid gland, pediatric brain, testes, mammary gland, eye ball, joints, musculoskeletal system etc. are highly popular among the referring physicians. Colour doppler study of the peripheral vessels, carotid arteries and other organs is being done routinely. Elastoscan, endocavitary scan and 4D Ultrasonography of fetus & different organs are also done here.

1.1.2 RIA laboratory

Serum T_3, T_4, TSH, FT_3, FT_4, FSH, LH, Prolactin, Progesterone, Testosterone, Thyroglobulin (Tg), Anti TgAb, TPO Ab, TRAb, TMAb are confidently estimated weekly and fortnightly.

1.1.3 BMD

Bone mineral density is done to detect the bone density.

1.1.4 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.

1.1.5 Radioiodine Thyroid Uptake

Radioiodine thyroid uptake is done to evaluate thyroid functional status.

1.2 Therapeutic Activities

- I-131 therapy: I-131 therapy is given to Hyperthyroid & Ca- thyroid patients
- Follow-up: Toxic & Ca-thyroid Patients are followed up periodically for the rest of their lives
- Beta-radiation: Beta-radiation is applied to Postoperative Pterygium patients using Sr-90 source

2. Research and Development Work(s)

- Outcome of radioiodine therapy in well differentiated Ca thyroid patients
- Pathologies found in high resolution neck Ultrasonography

3. Repair and Maintenance Works

A 4D colour doppler ultrasound machine, a BMD machine a thyroid uptake system has been installed by BAEC for INMAS Barishal

4. Manpower Development and Training Programme

Title of the event	Date	Place	No. of participant
Arranged In-house Training for Officer & Staff	16 Jun. 2022	INMAS, Barishal	26
Guidelines for annual performance (APA)	18 Jun. 2022	INMAS Barishal	4

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

Name of the participant	Title of the event	Organizer	Date	Place
Dr. N. Jahan	TEIN Lecture series 2022 1st Semester " (Virtual lectures)	KOICA	2 Mar. - 25 May 2022 (every Wednesday)	Zoom platform
	26th WFUMB COE Workshop	BSU	4-5 Mar. 2022	Zoom platform
	Directors meeting	BAEC	19 May 2022	BAEC, HQ
	25th National Conference of Society of Nuclear Medicine Bangladesh	SNMB	20 May 2022	BICC, Dhaka
	APA meeting	BAEC	20 Jun. 2022	BAEC, HQ
Dr. F. Sharmin	Right of Information and remedy of dispute & GRS software	BAEC	19 Apr. 2022	Zoom platform

Name of the participant	Title of the event	Organizer	Date	Place
	25th National Conference of Society of Nuclear Medicine Bangladesh	SNMB	20 May 2022	BICC, Dhaka
Dr. N. Jahan	25th National Conference of Society of Nuclear Medicine Bangladesh	SNMB	20 May 2022	BICC, Dhaka
Dr. M. S. Hossain	25th National Conference of Society of Nuclear Medicine Bangladesh	SNMB	20 May 2022	BICC, Dhaka
D. S. Kumar	Implementing SDG Related Learning Session	BAEC	02 Mar. 2022	Zoom platform
M. M. U. Alhmahomud	Right of Information and remedy of dispute & GRS software	BAEC	19 Apr. 2022	Zoom platform
	NIS & Good Governance Related Training	BIM	22 Jan. 2022	Zoom platform
A. K. Kalifa	Implementing SDG Related Learning Session	BAEC	02 Mar. 2022	Zoom platform
M. M. Rahman	Conduct Rules & others	BAEC	20-23 Jun. 2022	TI, AERE
N. Molla	Conduct Rules & others	BAEC	20-23 Jun. 2022	TI, AERE

6. Academic Activities

- Review of journals on nuclear medicine and Ultrasonography procedures on monthly basis
- Lectures delivered to 3rd year (50th batch) students of SBMC on 1-4 Jul. 2022

7. Stakeholder Meeting

Stakeholder meeting arranged by MOST on establishing good governance in the INMAS, Barishal auditorium on 1 Jun. 2022

8. Service Rendered and Revenue Income

Name of the service	Number of patient	Revenue income
Patient service	33247	1,83,25,280/-

INSTITUTE OF NUCLEAR MEDICINE AND 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. Patients service

Principal activities of the institute are to render diagnostic and therapeutic service to the patients. A large number of patients attend the institute for ultrasonogram, thyroid function studies, radioisotope scan and for estimation of different hormones. The institute also renders therapy for thyrotroxicosis and ca-thyroid patients.

2. Research and Development Work(s)

The institute has been doing number of research works in the discipline of ultrasound and nuclear medicine. Few of the undergoing works are mentioned below-

- Duplex study of inferior thyroid arteries and correlation with biochemical status
- Prevalence of fatty liver and pancreas—an ultrasound study
- Ultrasound evaluation acute appendicitis and clinical correlation

3. Manpower Development and Training Programme

- Scientific training on "Basic Nuclear Medicine and Administration" for officers and stuff organized by INMAS, Faridpur 8-17 Feb., 2022.
- Dr Afrida Khanom MO, MD on Nuclear Medicine course in 2022.

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

Name of the Participant	Title of the event	Organizer	Date	Place
Dr. S. K. Dey	"Scrotal Ultrasound Workshop"	BSU	16 Jul. 2021	Virtual
	Training on "NIS and good governance"	BIMU	22 Jan 2022	Virtual
Dr. S. Kr Dey and Dr. A. Khanam	33 National Conference of BSU	BSU	8 Oct. 2021	Virtual
Dr. S. K. Dey, Dr. M. H. Rahman and Dr. A. Khanam	25th SNMB National Conference	SNMB	14 May 2022	Dhaka
Dr. I. Khalil and Dr. R. Chanda	Capacity Development of officers on contemporary subject		10 Mar. 2022	Virtual
	^{5th} National conference of Bangladesh Thyroid Society	BTS	17 Jun. 2022	Dhaka

5. Service Rendered and Revenue Income

Name of the service	Number of patient	Revenue income
Patients service including Ultrasound and Doppler, Scintigraphy, radioiodine therapy	10595	1,38,78,900/-
Blood sample and analysis	13994	
Total	24589	1,38,78,900/-

INSTITUTE OF NUCLEAR MEDICINE AND **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 Programme

Title of the event	Date	Place	No. of participant
কর্মকর্তা-কর্মচারীগণের অংশগ্রহণে সুশাসন সংক্রান্ত প্রশিক্ষণ	31 Aug. 2021	INMAS, Bogura	39
কর্মকর্তা-কর্মচারীগণের অংশগ্রহণে শুদ্ধাচার বিষয়ক প্রশিক্ষণ	14 Sept. 2021	INMAS, Bogura	36
Training Course on Radiation Protection for Radiation Workers and RCO's of BAEC Medical Facilities & Industries	24-28 Oct. 2021	Training Institute, AERE	1
সরকারী নিরিক্ষা ও উন্নততর আর্থিক ব্যবস্থাপনা বিষয়ক প্রশিক্ষণ	26-27 Nov. 2021	BIM, Dhaka	1
কর্মকর্তা-কর্মচারীগণের অংশগ্রহণে শুদ্ধাচার বিষয়ক প্রশিক্ষণ	12 Dec. 2021	INMAS, Bogura	34
অচঅগঝ সফটওয়ার বিষয়ক প্রশিক্ষণ	30 Dec. 2021	Zoom Platform	1
জাতীয় শুদ্ধাচার ও সু-শাসন বিষয়ক প্রশিক্ষণ	22 Jan. 2022	Zoom Platform	1
এসডিজি বাস্তবায়ন সংক্রান্ত লার্নিং সেশন/কর্মশালা	2 Mar. 2022	Zoom Platform	2
কর্মকর্তাগণের অংশগ্রহণে শুদ্ধাচার বিষয়ক প্রশিক্ষণ	6 Mar. 2022	INMAS, Bogura	12
তথ্য অধিকার এবং অধিকার প্রতিকার ব্যবস্থা ও জিআরএস সফটওয়্যার বিষয়ক প্রশিক্ষণ	19 Apr. 2022	Zoom Platform	2
গ্রেডভূক্ত কর্মচারীগণের অংশগ্রহণে শুদ্ধাচার বিষয়ক প্রশিক্ষণ	7 Jun. 2022	INMAS, Bogura	26
চাকুরীর আচরণবিধি ও নিয়ম-শৃঙ্খলা সংক্রান্ত প্রশিক্ষণ কোর্স	21-23 Jun. 2022	INMAS, Bogura	2

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

Name of the Participant	Title of the event	Organizer	Date	Place
Md. F. Hossin	International e- Conference on Physics -2021	BPS & DU	6-7 Aug. 2021	Online Platform
	Webinar on PET-CT in Lymphoma	SNMB	1 Apr. 2022	Online Platform
Dr. M. A. Awal, Dr. S. A. Chowdhury, Dr. S. Sarmin, M. F. Hossain, Dr. N. Tarannum, M. A. S. Akanda, M. A. Matin, M. J. Haque and M. M. Rhaman	25th National Conference-SNMB	SNMB	20 May 2022	BICC

3. Stakeholder Meeting

Arranged stakeholder meeting on 1 Jun. 2022 including 6 participants.

4. Service Rendered and Revenue Income

Name of service	No. of sample/patient	Revenue income
Patient Service	11168	53,59,690/-
Sample Analysis (including blood sample)	15820	1,11,77,320/-
Total	26988	1,65,37,010/-

INSTITUTE OF NUCLEAR MEDICINE AND ALLIED SCIENCES (INMAS), CUMILLA

Introduction

INMAS, Cumilla is established in 1996, which located at Cumilla Medical College Campus. This institute, provides diagnostic and therapeutic treatment service by using nuclear medicine technique, Ultrasound & Color duplex Case of the patients east part of Bangladesh covering Cumilla, Feni, Noakhali, Chandpur, Laxmipur, B.baria etc.

Activities

1. Research and Development Work(s)

This institute is equipped with one Bone Mineral densitometry (BMD) machine, One conventional ultrasound , one Color Doppler Ultrasound and one thyroid gamma camera machine.

2. Manpower Development and Training Programme

Title of the event	Date	Place	No. of participant
Skill Development Programme	16-18 Apr. 2022	INMAS, Cumilla	21

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

Name of the Participant	Title of the event	Organizer	Date	Place
Dr. M. R. Islam	Training on Color Doppler Ultrasound Machine Equipped	M/s New Vision Medi System	20-29 Dec. 2021	NOIDA, India
	Training on Thyroid Gamma amera Machine	M/s Mediso Medical Imaging Systems Ltd.	23-29 May 2022	Budapest, Hungary

4. Service Renderd and Revenue Income

Name of service	No. of patient	Revenue income
Sample Analysis (including blood sample)	14,158	1,48,04,550/-
Patient Service (Renogram, Bone Scan, Thyroid Scan, Ultrasound & Follow-Up)	7,225	

INSTITUTE OF NUCLEAR MEDICINE AND ALLIED SCIENCES (INMAS), COX'S BAZAR

Objective

- Ensuring the safe uses of nuclear medicine in diagnostic and therapeutic procedures
- Ensuring the clinical use of radionuclides applied in nuclear medicine
- Development of skilled human resources in the field of nuclear science and technology
- Ensuring safety and peaceful use of nuclear energy
- Expanding the uses of nuclear technology in medical service
- Increase research capacity in science and technology
- To increase transparency and ensure accountability in official activities
- Bringing dynamism in performance and increasing the quality of service

Activities

1. Services

- Providing services by regular follow up of thyroid patients
- Radio Iodine Therapy
- Scintigraphy and Ultrasound Services

- RIA Activities
- Clinical research in nuclear medicine and thyroid disorders

2. Manpower Development and Training Programme

Title of the event	Date	Place	No. of participant
Training to National Integrity Development and planning	26 Jun. 2022	INMAS, Cox's Bazar	08

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

Name of the participant	Title of the event	Organizer	Date	Place
Prof. Dr. M. S. Alam	"5th National conference and Annual General Meeting of Bangladesh Thyroid Society"	Bangladesh Thyroid Society	17 Jun. 2022	Hotel Sonargao Dhaka
	"Training on High End Premium Level 4D color Doppler Machine"	New Vision Medi System	26-30 Dec. 2021	INDIA
M. S. Islam	A Follow-up Training Course on "Nuclear and Radiological Emergency Preparedness"	Training Institute	21 Nov.- 2 Dec. 2021	AERE, Savar

4. Service Rendered and Revenue Income

Name of service	No. of patien/samples	Revenue income
Patient Service	5,348	33,94,130/-
Sample Analysis (including blood sample)	8,319	
Total		33,94,130/-

III. ENGINEERING AND GENERAL SERVICES

ENGINEERING DIVISION (ED), BAEC HQ

Introduction

Bangladesh Atomic Energy Commission has been engaged in research and development (R & D) activities in the various fields of Nuclear Science and Technology in the country. Under the Charter of Bangladesh Atomic Energy Commission, Engineering Division (ED) has been entrusted with the responsibilities for installation, testing and operation of various scientific, nuclear and engineering facilities and building up & maintenance of physical infrastructures for smooth operation of R&D programmes of BAEC. This division is also actively involved in the implementation of 2400 MW Rooppur Nuclear Power Project (RNPP) at Ishwardi, Pabna.Following activities have been performed by Engineering Division during 2021-2022periods.

Activities

1. Contribution in Implementing of Various ADP Projects of BAEC (both completed and ongoing)

a. Works Contributing Under The Project "Establishment of Institute of Nuclear Medicine and Allied Sciences (INMAS) at 8 Medical Collage Hospital Campuses in the Country "at Dhaka, Khustia, Jessore, Cox's Bazar, Gopalgonj, Pabna, Satkhira

- Planning, designing, estimating and supervision of all new INMAS buildings are in progress
- Construction, installation of substations, lifts, ACs, pumps and other related mechanical and electrical works are in progress

b. Works Contributing Under The Project "Enhance Capacity of Institute of Nuclear Medicine and Allied Sciences (INMAS) at Dhak

c. Chittagong, Khulna, Sylhet, Rajshahi, Dinajpur and Rangpur"

- Planning, designing, estimating and supervision of renovation worksof old INMAS buildings
- Construction of six storied new building in Dinajpur, three storied in Khulna and Rajshahi, one storied in Chittagong and also vertical extension in Rangpur
- Construction and installation of lift, AC, Sub-station are in progress
- Construction of new gate and guard room at INMAS Dhaka
- Construction and supervision of auditorium buildings under the project

d. Works Contributed for Planning, Designing, Estimating and Construction of Three Storied New Residential Building under the Project "Development of Human Resources & Establishment of Residential Accommodation Facilities for the Radiation Testing and Monitoring Laboratory", at Mongla.

e. Works Contributed Under The Project "Capacity Build-Up of Nano and Nano-Bio Technological laboratory" at Material Science Division, AEC, Dhaka

- Planning, designing and estimation for renovation of laboratories of Material Science division at AECD
- Installation, testing and commissioning of Air Conditioning system and other related mechanical and electrical works

f. **Works Contributed Under The Project "Establishment of Positron Emission Tomography–Computed Tomography (PET-CT) with Cyclotron facilities" at AERE**, **Savar**

- Installation, testing and commissioning of 1000KVA new Sub-station
- Installation, testing and commissioning of 300KVA generator and other related electrical and mechanical works

g. Similar Works Contributed for The Project "Balancing, Modernization, Refurbishment and Extension (BMRE) of Safety Systems of the 3 MW TRIGA Mark-II Research Reactor Facilities".

h. Similar Works Contributed for The Project "Establishment of Cyclotron & PET-CT at Institute of Nuclear Medicine & Allied Sciences (INMAS) Mymensingh& Chittagong and Cyclotron Facilities at Institute of Nuclear Medical Physics (INMP), Savar"

i. Similar works contributed for the project "Establishment of Calibration and Quality Control Facilities for Radiotherapy, Diagnostic Radiology and Neutron"

2. Works accomplished by Engineering Division in (2021-2022) under Revenue Budget

Engineering Division is one of the most important divisions of this organization, as it is responsible to smoothly operate the overall R&D activities of BAEC by creating various facilities, work and services. Some completed works andrelated services rendered within the financial year 2019-2020 are given below:

2.1 At BAEC HQ, Dhaka

- Successfully completion of various civil, electrical and mechanical works under Vertical Extension works of ParamanuBhaban at BAEC, HQ
- Supplying, fitting and fixing of office furniture for Human Resources Division at BAEC, HQ
- Supplying, installation, testing & commissioning of split, cassette and window air conditioners at BAEC, HQ
- Supply, installation, testing and commissioning of 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
- 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, Agargaon, Dhaka
- Supplying, fitting & fixing of vertical venetian blinds of Physical Science Division at BAEC, HQ, Dhaka
- Supplying, Fitting, and fixing office furniture at chairman Office secretariat of BAEC, HQ. Dhaka.
- 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 HQ

2.2 At BAEC Housing Colony, Banani, Dhaka

- Construction of new sewerage system at BAEC Housing Colony, Banani
- Construction of passenger waiting shade at BAEC Housing Colony, Banani
- Installation of new LED display at the main gain of BAEC Housing Colony, Banani
- 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 at BAEC, housing colony, Dhaka
- Renovation/repair and maintenance works of Flat No: D-3, HB-9 & pump house at BAEC, housing colony, Dhaka
- Renovation/repair and maintenance works of C-06, 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 works of flat No C-19 at BAEC, HQ
- Renovation/repair and maintenance of flat No C-01, 10& 11 at BAEC housing colony, Dhaka

2.3 At AERE Campus of BAEC

- Repair and renovation of Energy Building at AERE, Savar, Dhaka.
- Supply, installation, testing and commissioning of outdoor LED display billboard [18.5ft x 13ft] at AERE, Savar, Dhaka
- Construction of 2 no's, gate and gate house in front near side of road adjacent to guest house) at BSMEC, Cox's bazar

2.4 At NINMAS and INMAS's

- Renovation/repair and maintenance works at INMAS, Cumilla
- Renovation/repair and maintenance works at INMAS, Bogura Old Campus
- Repair and maintenance works at INMAS, Mitford, Dhaka

3. Completed Services

- Works contributing under the project "Modernization of Food and Radiation Biology Facilities" AERE, Savarare as follows:-
- Planning, designing, estimating and supervision of vertical extension of old IFRB building and others related renovation works

- Construction and installation of lift, AC, Sub-station are in progress
- Rendered various services related to planning, designing, drawing and sanitation work (civil, electrical, mechanical & sanitary) at various divisions /facilities of BAEC HQ, Agargaon, Dhaka
- Rendered various services related to planning, designing, drawing, and sanitationworks (civil, electrical, mechanical & sanitary) at various facilities of Bangladesh Atomic Energy Researches Establishment, Savar, Dhaka
- Rendered various services related to planning, designing, drawing, sanitation works (civil, electrical, mechanical & sanitary) at various facilities of BAEC Housing Colony,Banani, Dhaka
- Rendered planning & designing services (civil, electrical, mechanical and sanitary) contributed to various facilities at Bangladesh Atomic Energy Regulatory Authority (BAERA)
- Rendered planning & designing services (civil, electrical, mechanical and sanitary) contributed to various facilities of Dhaka, Shylhet, Rajshahi, Chittagong, Dinajpur, Rangpur, Khulna INMAS

  a. Providing technical expert services in various Centers/institutes/different projects of BAEC and other National Projects outside BAEC like, Department of Environment, Ministry of Commerce (Bangladesh Trade Portal Enhance Project), University Grant commission (UGC), Bangladesh Museum of Science and Technology etc.

4. Manpower Development

No manpower development programme was organized during the financial year 2021-2022 because of Covid-19 situation

5. Preparationof Development Project Pro-forma (DPP) in 2021-2022

This division is also responsible for estimation and preparation of DPP of various government ADP projects under BAEC. Some similar ADP projects are given below:

- "Technical Study Project to Establish High Power Research Reactor in Bangladesh"
- "Specialized Hospital for Ruppur Nuclear Power Plant"
- "Establishment of Calibration and Quality Control Facilities for Radiotherapy, Diagnostic Radiology and Neutron"
- "Establishment of Cyclotron & PET-CT at Institute of Nuclear Medicine and Allied Sciences (INMAS) Mymensingh& Chittagong and Cyclotron facilities at Institute of Nuclear Medical Physics (INMP)", Savar
- "Balancing, Modernization, Refurbishment and Extension (BMRE) 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"

ENGINEERING AND GERNERAL SERVICE DIVISION, AECD

Objective

The objective of this division is to provide Engineering and technical services to research and development activities in the Atomic Energy Centre, Dhaka. This division has seven sections: Electrical, Refrigeration & Air Conditioning system, Plumbing, Workshop, Glass Blowing, Utility & Civil Engineering section and Welding section to support divisional activities. This division also provides all utility services such as Electricity, Water supply, Air-conditioning (AC) system; Civil works etc. through the respective sections. During the report period this division received over 86 jobs requisition from different division of AECD, RNPP, BAEC HQ and AERE and has performed respective jobs successfully.

Facilities

- Heavy Machineries (Lathe, Shaper, Milling, Drill Machine, etc.)
- Precision Tools
- Surface Grinding Facilities

- Plumbing Facility
- Electrical Motor, Fan, Re-winding Facility etc.
- 11 KV (1000 KVA and 500 KVA) Sub-station Facilities
- Solar Energy Plant (2.2 KW) Power Supply Facility

Services Available

- Implementation of various services related to repair & maintenance works (Civil, Electrical, Mechanical & Sanitary) of various facilities of AECD
- Planning & Designing Services (Civil, Electrical, Mechanical and Sanitary) contributed to various facilities (Institutes/Establishment/Centers) of BAEC

Activities

Electrical Section

- Repair Solar system water pump in Electronics Division
- Tube lights were replacement in corridors and Library room
- Repair Fan and electrical line in Accounts section
- Repair and replace tube lights in Officers sitting room
- Repair Fan in and adjust lights in A.O.s room
- Repair Air pollution sampler machine in time
- Repair Split type AC power and Light in ACL, Trace Analysis Lab.
- Fume Hood fan repair and fixed in Chemistry lab.
- AC Power repair in Scientist sitting room
- Repair AC power and circuit breaker in Chemistry lab.
- Fume Hood fan repair and fixed in Health Physics Division
- Repair and maintenance light and combined socket in Health Physics division
- Repair a Electrical circuit in Health Physics division
- Light and energy bulb fixed in NDT division

Refrigeration and Air-Conditioning System Section

- Total 7 AC were repaired in Administration, Accounts, Store and Library section
- Total 8 AC were repaired (i.e. gas charge, circuit, compressor, blower etc) for all Labs in Chemistry Division
- Three AC were repaired in Health Physics division (HPD)
- Four AC were repaired in NDT division
- Two AC were repaired in the Solar Physics division (SPD)
- Three AC were repair and service in XRD Lab, Material Science division (MSD)
- Two AC were repair and servicing in the Electronics division (ED)
- Split type 2 AC repair in AF Division
- Repair and fix 2 AC in Scientist sitting room

Plumbing Section

- Repair and fix water drainage system in a Fume hood in Chemistry Division
- Repair 3 door lock in Chemistry Lab.
- Repaired four Basin, hand wash stand, and toilet flash for Analytical Chemistry Lab.

- Repair water supply system in both Male and Female toilet
- 2 Basin placed and fix in Health Physics Division
- Connect water supply and repair water tape in Material Science Division
- Repair gas line and sink in canteen
- Hand shower, chair, door lock for Officers room repaired, window repaired for sitting room in Administration
- A sink repair and placed in Establishment section
- Water pump repair fixed and for Electronics division

Workshop Section

- Repair Metal body pot for MSD Lab.
- Made hole and bend MS pipe according to sample in RAC section
- Made a solid Iron rod pusher for Administration section
- Adjust door lock for E & GS

Glass Blowing Section

During the mentioned period, this section has performed 4 glass related work for AERE, research student from Jahangirnagar University and Chemistry division

CENTRAL ENGINEERING FACILITIES (CEF), AERE

Introduction

CEF mainly works in construction of infrastructures and installation, repair & maintenance of the necessary equipments as well as providing the different services within Atomic Energy Research Establishment (AERE).

The fundamental works of CEF are to help all the institutions of AERE to carry out various sorts of R&D work by providing essential technical supports. It has been taking care of the engineering facilities within AERE campus as per requirements. CEF takes the responsibility of formulating all engineering related jobs like as designing, planning, installation, operation and maintenance of all facilities of AERE, the largest research complex of Bangladesh Atomic Energy Commission (BAEC). Electrical power supply system, gas supply system, water supply system, air conditioning system civil and sanitation system of AERE are the prime concern of CEF. In essence, it provides services in designing, development, construction, technical support, implementation and maintenance of the infrastructures developed at AERE.

Activities

1. Repair, Maintenance, Operation and Renovation Works

Mechanical Engineering Division, CEF, AERE

- Supplied drinking water which is used in different Institute of the office side and residential area of AERE colony
- Installed, Modification & Commissioning of new 30 HP Capacity Building Service Centrifugal Pump Motor Set, Star Delta Motor Control Panel & Slice Valve /gate Valve including necessary others accessories at AERE Saver, Dhaka
- Replaced of damage water heater from VIP guest house of room no -1 and installed new 15 letter automatic electric water heater with modification of existing water line
- Repaired & maintenance works and replacement of damage gas burner and installed new gas burner from different residential building at AERE. Approximately 15 nos. gas burner repaired and new installed 25 nos.
- Repaired & maintenance works of natural gas line and gas regulator, lock wing cock, Uzala key etc. As per requirement of different user at AERE campus

- Repaired colony side 25 HP centrifugal pumps 3C, 3B & 3A
- Replacement electric motor of colony pumps 3C
- Repaired office side 25 HP centrifugal pumps 2A
- Rewinding and repaired electric motor of office side pump 2B
- Installation & modification works of ball cock for overhead water tank of colony building at AERE, Savar
- Installed & modification of underground water pipe line for INST & IFRB at AERE
- Cleaning and washing works of underground and overhead water tank at AERE campus
- Operated & maintained two deep-well turbine pump & six centrifugal pumps regularly
- Installed 16 nos. new split and window type air cooler (5 ton, 2 ton &1.5 ton) at INST, IFRB, IE, ICS, TAD, & CAD building
- General servicing around 40 nos. of window & split type A/C in all institutes at AERE
- Repaired 20 nos. of window & split type AC at INST, IFRB, TI, IE, ICS, VIP guest house, TAD, Cafeteria, INM & CAD building
- Replaced around 12 nos. of blowers of window & split type, 16 nos. of compressor of AC & refrigerator and repaired around 17 nos. of refrigerator & fridge in different institutes of AERE
- Repaired other refrigeration systems (Cooling incubator, Dehumidifier etc.) at AERE
- Operated & maintained the central Air conditioning Plant of INST auditorium
- Installation and refilling works of fire extinguisher at AERE
- Replaced around 25 nos. gas burner of residential colony at AERE
- Provided overhauling, repairing, servicing, testing and commissioning of 40 ton once thru air conditioning, ventilation and exhaust system of INST Auditorium at AERE

Electrical Engineering Division, CEF, AERE

- The power supply system of Autoclave machine at Insect Biotechnology Division (IBD), IFRB was damage. Necessary repair works have been done and a 15 Ampere power socket is being installed
- The Ball Milling machine at Reactor Physics & Engineering Division (RNPD), INST was found to faulty in electrical power connection. Repair work and electrical connected to Ball Milling machine has done to the machine working properly
- The light circuit for Laminar Air Flow machine at Gamma Source Division (GSD), IFRB was found to burn. After necessary repair, new light circuit has been installed is connected to power
- The power terminal plug of Electric Furnace machine at Institute of Tissue Banking and Biomaterial Research was damaged. Necessary repair works and installation of new terminal plug have done
- The power switch of Oven was out of order. Necessary repair works have been done and new power switch was installed at INST. Repaired Oven machine was working properly
- The power Socket of PH meter machine at Gamma Source Division (GSD), IFRB was out of order. Necessary repair works have been done and 3-pin 10A ampere MK socket was installed
- The Vacuum Oven machine power system was not working at IFRB. After through checkup it was found that the power terminal connector did not get proper voltage from the power supply. Proper voltage supply ensured by servicing. It is working properly
- The power socket of Magnetic Stirrer machine at Nuclear and Radiation Chemistry Division (NRCD), INST was damaged. After necessary repair and installation work has done. The machine was working properly
- The power switch of water bath 4 holes digital machine at Nuclear and Radiation Chemistry Division (NRCD), INST was out of order. Necessary repair works have been done and power switch was installed

- The centrifuge machine at Reactor Physics & Engineering Division (RNPD), INST was out of order. It was checkered thoroughly. A terminal power indicator lamp was out of order and a indicator was burnt. Power indicator was replaced by new one and electrical connection was properly.
- The Autoclave machine at Food Technology Division (FTD), IFRB was found to faulty in electrical power connection. Repair work and electrical connection to Autoclave machine has done to the machine The Mosquito Larva Counter machine at Insect Biotechnology Division (IBO), IFRB is currently procured. A 3-pin MK socket along with the cable has been installed for the machine.
- The Mosquito Pupae Counter machine at Insect Biotechnology Division (IBO), IFRB is currently procured. A 5-pin MK socket along with the cable has been installed for the machine
- Renovation, repaired & maintenance works of VIP guest house with necessary modification at AERE.
- Electrical repaired of security lights of IRPT, SIU, EI & INST building at AERE
- Electrical repaired of ceiling fan of IE, INM & CAD building at AERE
- Routine repaired, maintenance & operation works of electrical engineering division were being continued for any requirement from different institute at AERE. Like as electricity supply system. Electrical division also involved to maintain others equipment & machineries such as generator, transformer, VCB, HT & LT panel, PFI Plant, motor, air compressor etc.

Civil Engineering Division, CEF, AERE

- Repaired maintenance & painting work of office room of central finance and accounts department at AERE
- Repaired, maintenance & modification work for false ceiling of INST Auditorium at AERE
- Repaired & maintenance work of Isotope Hydrology room no.116 with making one partition and necessary modification at AERE
- Repaired, maintenance & construction work of an Animal Rearing house for VDRAD of IFRB at AERE.
- Repaired & maintenance work with necessary modification of lab sitting of FTD S-103, S-104, S-105, S-105(A), S-106, S-107, S-109, S-110, S-206, S-207, S-213 and one lab room (beside S-207 room) of IFRB at AERE
- Repaired, maintenance & modification work of AERE Mosque roof top at AERE colony
- Repaired & maintenance work of quarter no. C-1/4, C-1/7, C-2/3, C-2/5, C-2/6, C-3/6, C-3/7 and officer's hostel room no. 116 & 117 at AERE colony
- Constructed of a septic tank with new sewerage line & other related works of ladies toilet of INST at AERE
- Made pocket gate & and closed the pocket gate after installation the equipments of energy building 1st floor at AERE
- Repaired & maintenance work of quarter no. D-1/2, D-1/5, D-2/5 and D-2/7 at AERE
- Repaired & maintenance work of a Sitting Room of PBGED of IFRB at AERE
- Repaired, maintenance & modification work of CEF old building 1st floor toilet zone at AERE
- Repaired, maintenance & modification work of HPRWMU building and toilet at AERE
- Repaired, maintenance & modification work of common toilet zone of INST (prayer hall) at AERE
- Repaired, maintenance & modification work of CAD Prayer room and other related works at AERE
- Repaired, maintenance & modification work of common toilet zone (ground floor) of CAD building at AERE

Workshop Engineering Division, CEF, AERE

- Provide welding & marching works as the requirement of different institute at AERE
- Work has been done on the railings of IRPT Co-60 gamma source at AERE

- Made of steel mould (06-nos) NRCD non-RCA Project RAS-1024 of INST at AERE
- Repaired steel door substation work of Tandem accelerator facilities at INST
- Repaired & maintenance works of collapsible gate of SIU at AERE
- Repaired, maintenance works of main gate at AERE
- Repaired & maintenance work of window glass, door lock, door frame & shutter for different Institutes of AERE
- Made of change of over switch box (06-nos) of RICD, IE at AERE
- Repaired & maintenance works of grip of TS machine of NRCD at INST
- Provided thread cutting of water tank pipe of E-2 building at AERE colony
- Made wood frame for project setting of INM
- Repaired & maintenance regularly of the existing facilities based on damage at AERE
- Provided materials and made of 01 nos. cot of staff hostel at AERE
- Performed marching, welding, sheet-metal works, carpentry works etc. when as required
- Repaired & maintenance works of related to door, window, furniture of office and colony side at AERE
- Made of glass mould (7-nos) different laboratory at AERE
- Made of steel rack for laboratory research work of different institute at AERE
- Made of wood box for collected rain water sample send to IAEA, Vienna, Austria through of IHD at INST

IV. INTERNATIONAL AFFAIRS DIVISION (IAD), BAEC HQ

Introduction

International Affairs Division (IAD), Bangladesh Atomic Energy Commission (BAEC), has been maintaining assigned liaisons regularly with the international organizations and foreign countries since its inception. The liaisons are bordered normally to the nuclear technology transfer, enrichment of nuclear instrumentation, establishing nuclear power plants and development of human resources for the peaceful application of nuclear science & technology in the country. Under the supervision of BAEC, IAD directly communicates with international organizations to get international projects and simultaneously monitors the progress of the implementing projects.To strengthen the overall nuclear capability of the country, this division makes liaison for foreign trainings, fellowships and scientific visits for scientists, engineers, doctors, geologists, technicians and administration personnels. In the financial year 2021-2022, IAD has processed nominations of approximately 118 participants for various online/offline international programmes in different countries. 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.

1.1Technical Cooperation (TC) Projects

In the financial year 2021-2022, IAD worked for 12 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 resurces. These projects are also aligned to our SDG.

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 22 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 20 RCA projects covering different nuclear fields namely- Agriculture, Human Health, Industry, Environmental Protection and Water Resources.

1.3 Non- RCA Projects

Non-RCA projects are based on Asia Region supported by the IAEA Technical Cooperation (TC). In these projects, countries from Middle East are also involved with the 22 RCA countries. In the reported year, IAD made liaison for 33 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 total cost of the project. Presently IAD liaisons for a number of 13 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.

1.5 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 2021-2022, IAD made liaison for a number of seven (7) FNCA projects.

2. Exchange of Experience and Expertise

Exchange Programmes 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 programme, IAD processed the necessities in favor of the selected scientists, engineers, doctors and technicians of BAEC. Both of these exchange programmes or heplful 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.

3. Follow-up Training Course (FTCs) Instructor Training Courses (ITCs), Advance Instructor Training Courses (AITCs) and Oneline Training Courses (OTCs)

During the reported period, a Follow-up Training Course (FTC) is conducted in Dhaka with the help of Japanese and Bangladeshi experts. Through the FTC Eighteen (18) participants are trained in Enviromental Radiaoactivity Monitoring. About 22 participants have completed ITC, AITC & OTC during the prriod. All the courses have been conducted online due to Covid-19 pandemic situation.

4. Database of Foreign Visitors

From July 2008, IAD has been maintaining database for the foreign visits of employees of BAEC. This

includes various conferences, meetings, trainings, workshops organized by IAEA, FNCA, RCARO, CTBTO, ICTP, JAEA etc. Officials from BAEC, MoST and other govt. organizations have attended conferences, meetings, workshops and have availed significant number of fellowships and trainings in the reported period.

V. NUCLEAR POWER AND ENERGY DIVISION (NPED), BAEC 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 programme 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 programme in Bangladesh. NPED is playing an important role to assess the possibility of implementing nuclear power project and work with the assessment of primary energy mix in Bangladesh. This division is also playing a vital role to select another site for nuclear power plant in the southern region of Bangladesh.

Activities

1. Construction of Rooppur Nuclear Power Plant

Regarding the implementation of "Construction of Rooppur Nuclear Power Plant (RNPP) Project", activities namely, Incoming Control Inspection at RNPP Construction Site for Long Term Manufacturing Equipment (LTME) and Supply Equipment (SU) (Non-LTME); Reviewing the achievement of milestones in Long Term Manufacturing Equipment (LTME) and Supply Equipment (SU) (Non-LTME); Visiting, inspecting and auditing sub-contractor organizations namely Bangladesh Building Systems Ltd. (BBSL) and Sonargaon Steel Fabricate Limited appointed by General Contractor JSC ASE; Coordinating with Indian experts regarding consultancy services in the construction of 'Rooppur NPP'; and Reviewing Plan of Licensing and Permitting Activities at the Stages/Sub-Stages of Construction and Commissioning of 'Rooppur NPP' were performed by this division during this fiscal year.

Regarding the selection of another site for the construction of a nuclear power plant in the southern part of Bangladesh, a project titled "Probable site selection for construction of nuclear power plant in the southern part of Bangladesh" is completed. A combined ranking was accomplished based on all the observed parameters and applying normalization technique. According to the combined ranking of the selected sites, Nishanbari (East), Taltoli Upazila, Barguna; Nishanbari (West), Taltoli Upazila, Barguna; Moudubi, Rangabali Upazila, Patuakhali; Kumirmara and Padma mouzas, Sadar Upazila, Barguna; and Char Montaz, Rangabali Upazila, Patuakhali were ranked as the first, second, third, fourth, and fifth position, respectively. However, the combined ranking is inadequate to finalize the best site. So, another annual development project titled "Project on Evaluation of Preliminary Selected Sites for Construction of Nuclear Power Plant in the Southern Part of Bangladesh" is proposed to prepare guidelines/regulations for siting and ranking of the construction of NPP according to the IAEA guidelines and the perspectives of Bangladesh, to conduct gap analysis for the completed study of five selected sites according to the prepared guidelines/regulations; and to finalize the site for the construction of NPP.

Works related to the preparation of DPP for the establishment of National Nuclear and Radiological Emergency Management Center (NNREMC) was also cooperated from this division. Besides, the research works in the perspectives of nuclear safety and nuclear radiological emergency have also been performed in this division during this fiscal year.

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

Name of the participant	Title of the event	Organizer	Date	Place
M. Hossain	Inspection of the Manufacturing of LTME for the construction of Rooppur Nuclear Power Plant	RNPP Project	16 Jan.-15 Apr. 2022	Russian Federation

CONSTRUCTION OF ROOPPUR NUCLEAR POWER PLANT (RNPP)

Objective/Introduction

Rooppur Nuclear Power Plant (Rooppur NPP) is the first nuclear power plant of Bangladesh, currently under construction following the guidelines the IAEA and complying the regulatory requirement and terms and conditions of license issued by Bangladesh Atomic Energy Regulatory Authority. The Rooppur NPP contains two units with the capacity of 1.2GW each. The Plant is located on the bank of Padma in Pabna district of Bangladesh. Bangladesh is building Rooppur NPP under Ministry & Science and Technology with financial and technical support from the Russian Federation. With the commissioning of Rooppur NPP Bangladesh will become the third country in South Asia to have nuclear power. Nuclear power plant (NPP) generates low-cost electricity and meet modern society's demand for dependable and affordable electricity. The implementation of Rooppur NPP project with a total capacity of 2,400 MW is extremely important for the development of our country, as our goal is to turn on the lights in every Bangladeshi home, to achieve SDGs and to transform Bangladesh into developed nation. It will help in ensuring energy security and achieving energy independence of the nation.

Activities/Program(s)

Energy is critical for development and the role of energy in the development is reflected in a dedicated sustainable development goal- SDG 7 that aims to "access to affordable, reliable, sustainable and modern energy for all". While critical for development, the production and use of energy accounts for almost two thirds of total greenhouse gas emissions and creates a number of challenges. Nuclear power, hydro and other renewables are inevitable options to face with twin challenges of mitigating climate change by reducing emissions and meeting energy needs. Nuclear energy has unique characteristics: minimal waste production, more electricity generation on less land than any other clean-air sources, emits no pollution and no greenhouse gas, competitive production costs, independence of seasonal effects, advantages for energy security and fuel diversity.

Bangladesh considers nuclear energy for economic and social development,technological development, energy security and reduction of greenhouse gas emissions to avoid environmental calamities likeclimate change. The Power System Master Plan, 2016 projected the total electricity generation to beabout 60,000 MW by 2041 in which nuclear energy is targeted to be about10% of total generation by that period. This power situation will help us achieve SDG goals by 2030 in line with our development plan and facilitate graduation to a developed nation in 2041.

Bangladesh started construction of Rooppur NPP comprising two VVER-1200 water-cooled, water-moderated power reactors of the AES-2006 / V-392M design as a part of the development objective of the country. Each of the reactor units comprises a reactor and four circulation loops, each of which includes circulation pipelines, a reactor coolant pump, and a horizontal steam generator. The nominal thermal power of the reactor is 3.2GW, while the maximum utilization factor is more than 90% with a total gross capacity of 2,400 MWe.

Picture: Birds Eye View of Rooppur NPP Project Site

Rooppur Nuclear Power Plant, the first of its kind in Bangladesh, is being constructed at Rooppur, adjoining Paksey, in the Ishwardi Upazila of Pabna District, on the bank of the Padma River, approximately to the north - west of the capital - Dhaka. This project is implemented under the provision of the Intergovernmental Cooperation Agreement between the governments of the People's Republic of Bangladesh and Russian Federation. Bangladesh Atomic Energy Commission (BAEC) as Customer of Rooppur NPP, signed the General Contract for Rooppur NPP Construction with JSC Atomstroyexport, Engineering Division of Rosatom State Corporation. This design of Rooppur NPP is an evolutionary project of Generation III+ that fully meets international safety requirements. The power Unit-1 and Unit-2 have all kind of active, passive and engineering safety features of PWR type reactors along with new safety systems that include aircraft crash protection, hydrogen recombiners, passive heat removal system and a core catcher to contain the molten reactor core in the event of a severe accident.

The construction of Rooppur NPP began through the First Concrete for Power Unit -1was poured on 30

November2017 and for Power Unit-2 in 14 July 2018, respectively by the Hon'ble Prime Minister HE Sheikh Hasina.

1. Introduction of the Construction Areas ofRooppur Nuclear Power Plant

There are morethan 389 facilities/objects being constructed at Rooppur NPP project site mainly in theConstruction Erection Base-1 (CEB-1), Construction Erection Base-2 (CEB-2) andIndustrial and Common Facility Area.

1.1 Construction Erection Base-1 (CEB-1)

About 50 facilities/objects at CEB-1 have already been constructed and operational. That includes Engineering & Personnel Amenities Building, Parking and Service, Plant, Pioneer base, Electrical Service Building, Canteen, Water Sewerage System, laboratory, warehouse, concrete batching plants,construction material storage facilities,etc.

1.2 Construction Erection Base-2 (CEB-2)

About 100 facilities are constructed. The major facilities are equipment storage facilities, Engineering & Personnel Amenities Building, Incoming Inspection Shop, Laboratory, parking, Production & Personnel Amenities Building, Production & Personnel Amenities Building, Service Building, Storage, Warehouse, workshop, open site, electric charging point, Ventilation and Plumbing works, Waste Water Sewerage System, Storm Water Sewerage System, Diesel Power Station, workshops for electrical, mechanical and electromechanical worksetc.

1.3 Industrial and common plants area of Rooppur NPP

The main facilities in the Industrial areas are the Nuclear Island, Turbine Island and Balance of Plant as well as other supporting facilities of the reactor power Unit-1 and Unit-2. The nuclear island of each of the power units consists of Reactor Building, Reactor Auxiliary building and Transport Portal building. The Turbine Island of each power units consists of turbine building, demineralization building and normal power supply Building. There are many common facilities to power unit 1 and power unit 2.

2. Progress of Construction of Rooppur NPP Power Units

The earth works (total volume about 12,924,5000 cubic meter), concrete and reinforced concrete structures (1,023,750 cubic meter) and installation reinforcement (76,440 ton) workof Rooppur NPP are almost completed. In addition, about 70% of the installation of steel structures (total volume 56,030 ton) and 30% of installation of processing pipelines (65,770 ton) are completed.

2.1 Power Unit-1of Rooppur NPP

The reactor island of power unit 1 consists of reactor building (10UJA), Reactor auxiliary building (10 UKC) and the transport portal (10UJG). The construction of power unit – 1 of Rooppur began after receiving Construction License of Power Unit - 1 (2nd November 2017) from Bangladesh Atomic Energy Regulatory Authority (BAERA). The laying of first concrete of reactor building (10 UJA) foundation slab were performed on 30 November 2017. After that the foundation work of the 10UJA(-8.45 m to -5.45 m), reactor cavity (-4.9 m to +26.0m), concreting and installation work of reactor internal pit,spent fuel pool, different walls, columns, structures, sub-structures, crane columns, slabs including accident localization area (ALA) slab (at elev. +26.3m) and pressurizer slab (at elev. +35.1)and inner containment wall(up to elev.+61.7 m), transport portal, etc. are successfully completed.

Picture: Reactor Building of Power Unit-1

Installation of core catcher and support truss of reactor vessel were completed in the year 2019. Installation of 4 Active and 8 Passive Hydro-accumulators and welding of main circulation pipeline were completed on 23 July 2021 and 24 February 2022, respectively. Dome is both technologically complicated and one of the most dramatic stages in the construction of the Power unit. Installation of this complicated structure were completed on 30 July 2021. It is one of the main elements of the NPP safety system which not only protects the reactor compartment, but also

provides a support for pipeline penetrations and the polar crane and servicing the nuclear reactor. Installation of portal crane and putting the crane into operation according to certificate completed on 5 September 2021.

With all three tiers of the dome having been installed that allowed of the work for the installation of the Reactor Pressure Vessel (RPV). Installation of the 334-ton RPV completed on 10 October, 2021 marked the video link by Bangladesh's Prime Minister HE Sheikh Hasina. Installation of four steam generators at their permanent design positions are completed which allows starting welding works on the main circulation pipeline to connect the primary circuit equipment, such as: a reactor, steam generators and main circulation pump. Installation of 4 steam generators each of 350-ton into their design positions and installation of 4 coolant pumps completed on 29 November 2021 and 27 May 2021, respectively. The installation of bubbler tank, pressure relief tank, pressurizer and reactor circulation pump (spherical casing) completed on 25 August 2020, 25 April, 2021, 6 June 2021 and 20 June 2021, respectively.

The final stage of civil work in the Power Unit-1 is the installation work of the outer containment dome. It allows for the construction of passive heat removal system structures and equipment. The outer containment dome will be concreted after installation of its both parts. The pre-assembly works of outer containment dome are underway at the construction site and it will to be installed in October of 2022. According to updated schedule,all physical construction work and mechanical equipment installation work of 10UJA will be 100% completed by June 2023.

The construction work of Reactor auxiliary building (10 UKC) isalmost completed. Presently, concreting of staircases, painting work of different rooms and walls and fireproof door installation are being performed. Various equipment such as Pump, Heat exchanger, Primary Circuit Coolant Storage, Firefighting Water Collection Tank, condensate tank, Boric acid storage Tank, Boron Containing Water collection tank, Potassium hydroxide solution Tank, Boric solution supply pump, Electrically Driven Pump for SG have already been installed.

The turbine island consists of Turbine Building (10UMA), Unit Water Demineralization Plant Building (10UMX) and Normal Operation Power Supply Building (10UBA).In case of 10UMA,the foundation work,concreting and installation works of differentwalls,columns from -7.25 to elev. 0.00 and 0.00 to elev.+20.500 and slabs at different elevations (elev.0.00, elev+7.8, elev. +16.0 and elev. +20.5) and deck slab at elev.+32.2, installation work of the steel columns and frames up to elev.+47.20 and installation work of bearing roof truss are completed.The first stage and second stage concreting of turbine set foundation (turbo-generator foundation (TG deck) have been completed. Presently, fire proof painting of load-bearing steel structure, reinforcement works at elev. +32.20, installation activities of roof corrugated sheet,installation of metal support in different elevations,preparation for 3rd stage concreting ofTG deck and preparation for installation of sandwich panel are in progress.

In case of 10UMX, the foundation work, concreting and installation work of the different walls and columns from -7.25 to elev. 0.00 and 0.00 to elev.+20.500,slabs at different elevations (elev. -3.6m, 0.00, elev. +3.6m, elev+7.8, elev. +16.0 and elev. +20.5) and deck slab at elev.+32.2 and installation of steel structure at full height (up to elev. +47.200) completed.Presently, fire proof painting of load-bearing steel structure, installation activities of roof corrugated sheet, installation of metal support in different elevations and preparation for installation of sandwich panel are in progress.

Picture: Turbine Building of Power Unit-1

The foundation work and concreting and reinforcement work up to elev. +20.50m are completed for 10UBA.Concreting of all internal and external walls and slab at different elevations(elev. -3.6m, 0.00, elev. +4.8m, elev+7.8, elev. +12.5, elev. +15.6m and elev. +20.5) and steel work up to elev. +27.40 m completed. Presently, preparation for concreting of deck slab at elev.+27m, installation of streel structure above elev. +27.0m, floor finishing work at different elevations are in progress.

Installation of the generator stator, the heaviest element of the power unit equipment with a total weight ofover 440 tonshas successfully been completed in its design position in UMA. Completion of its installation in the design position allows us to proceed with full-scale works on installation of the turbine hall main

equipment.

The other major equipment installed in 10UMA are:Electrical Bridge Crane with Lifting Capacity of 180/32+6.3-ton, Electrical Bridge Crane with Lifting Capacity of 50/16+6.3ton, Deaerator tank, Condenser, Preliminary Filters of Circulating Water System, Condenser Tube Ball Cleaning System, MSR Stage-2 condensate tank and MSR Stage-1 condensate tank, Separate Collector, Condenser Vacuum Pumps, generator (stator and pressure ring) cooling system ion exchange filter, generator (stator and pressure ring) cooling system heat exchanger, Generator (stator and pressure ring) Cooling System Pumps, generator (rotor and stator core) cooling system ion exchange filter, generator (rotor and stator core) cooling system heat exchanger, Generator (rotor and stator core) Cooling System Pumps, Installation of Separator of Moisture Separator Reheater (MSR), High pressure heater-5,6, component Cooling System for Normal Operation Loads, Drainage System Tank (UMA Building), Drainage System pumps, MAV System Heat Exchanger, Generator set, Turbine Set, demineralized water pump, installation of feed electric pump.

There are two Evaporation Water Cooling Towers (11URA, 12URA) each of the height of about 175 m. Concrete bedding, Ring foundation, Basin Wall of the first and second cooling towers of the Power Unit 1 have been completed. Shell concreting of 11URA, 12URA have been completed up to a height of +103.77 m and +93.35m respectively

Picture: Cooling Towers of Power Unit 1&2

2.2 Power Unit-2 of Rooppur NPP

The reactor island of power unit-2 consists of reactor building (20UJA), Reactor auxiliary building (20 UKC) and the transport portal (20UJG). The construction of this power unit began on 14 July 2018 through the laying of the first concrete of reactor building foundation slab soon after receiving the Construction License of Power Unit - 2 (8 July November 2018) from Bangladesh Atomic Energy Regulatory Authority (BAERA). After that the foundation work of the 20UJA (-8.45 m to -5.45 m), reactor cavity (-4.9 m to +26.0m), arrangement of reactor shaft at elev. +22.60m, concreting and installation work of reactor internal pit, spent fuel pool, different walls up to elev. 16.50, columns, structures, sub-structures, crane columns, slabs at different elevations up to elev. + 16.5, ALA slab at elev.+26.3reinforcement and concreting of transport portal column up to elev.+29.5 m, installation of steel structures of beams and trolley of transport portalare successfully completed. Installation of inner containment dome metal structures were completed on 28 June 2022 and the concreting of inner containment wall up to elevation +47.6m is also completed. Presently, installation of metal liner in hermetic area at +26.3m, concreting of the remaining portion of the dome, concreting of columns of portal up to elev. +43.58 are being performed.

Picture: Reactor Building of Power Unit-2

Installation of core catcher, cantilever truss, Dry protection, PTU & RI inspection cavity, support truss of reactor vessel was completed in the year 2019. Installation of 4 Hydro-accumulators, Relief tank, Support Ring and Polar crane have been completed. Necessary preparation for installation of RPV into its designed position is in progress.

The construction work of Reactor auxiliary building (20 UKC) is about to be completed this year. The concreting work of inner wall, outer wall and slab of Reactor auxiliary building has been completedupto elevation +22.00m.Some major equipment, such as, Flushing Solution Supply Pump,Main Coolant Pump Oil Cooler Pump,Decontamination Solution Delivery Pump,Primary Coolant Water Purification Filter,Fuel Pool Water Supply Tank,Boric Acid Purification System Pumps etc have been installed.

Picture: Turbine Building of Power Unit-2

The turbine island of power unit 2 consists of turbine building (20UMA), Unit Water Demineralization Plant Building (20UMX) and Normal operation power supply building (20UBA). In case of 10UMA, the foundation work, concreting and installation works of different walls, columns from -7.25 to elev. 0.00 and 0.00 to elev.+20.500 and slabs at different elevations (elev. 0.00, elev+7.8, elev. +16.0 and elev. +20.5) and deck slab at elev.+32.2, installation work of the steel columns and frames up to elev.+43.5 are completed. The first stage concreting of turbine set foundation (turbo-generator foundation (TG deck) has been completed. Presently, installation work of bearing roof truss, and second stage concreting of turbine set foundation, painting work, reinforcement works at elev. +32.20, installation activities of roof corrugated sheet, installation of metal support in different elevations, are in progress.

In case of 20UMX, the foundation work, concreting and installation work of the different walls and columns from -7.25 to elev. 0.00 and 0.00 to elev.+20.500, slabs at different elevations (elev. -3.6m, 0.00, elev. +3.6m, elev+7.8, elev. +16.0 and elev. +20.5) and deck slab at elev.+32.2 and Figure: installation of steel structure at full height (up to elev. +47.200) were completed. Presently, preparation for installation activities of roof corrugated sheet, installation of metal support in different elevations and preparation for installation of sandwich panel are in progress.

The foundation work and concreting and reinforcement work up to elev. +20.50m are completed for 20UBA. Concreting of all internal and external walls and slab at different elevations (elev. -3.6m, 0.00, elev. +4.8m, elev+7.8, elev. +12.5, elev. +15.6m and elev. +20.5). Presently, preparation for installation of steel structure up to elev. +27.0m and floor finishing work at different elevations are in progress.

The other major equipment installed in 10UMA are: Electrical Bridge Crane with Lifting Capacity 180/32+6.3-ton, Electrical Bridge Crane with Lifting Capacity 50/16+6.3ton, Deaerator tank, Condenser, Preliminary Filters of Circulating Water System, Condenser Tube Ball Cleaning System, MSR Stage-2 condensate tank and MSR Stage-1 condensate tank, Separate Collector, Condenser Vacuum Pumps, generator (stator and pressure ring) cooling system ion exchange filter, generator (stator and pressure ring) cooling system heat exchanger, Generator (stator and pressure ring) Cooling System Pumps, generator (rotor and stator core) cooling system ion exchange filter, generator (rotor and stator core) cooling system heat exchanger, Generator (rotor and stator core) Cooling System Pumps, Installation of Separator of Moisture Separator Reheater (MSR), High pressure heater-5,6, component Cooling System for Normal Operation Loads, Drainage System Tank (UMA Building), Drainage System pumps, MAV System Heat Exchanger, Generator set, Turbine Set, demineralized water pump, installation of feed electric pump.

There are two Evaporation Water Cooling Towers (21URA, 22URA) for unit 2, each of the height of about 175 m. Concrete bedding, Ring foundation, Basin Wall of the first and second cooling tower of the Power Unit 1 have been completed. Shell concreting of 21URA, 22URA have been completed up to a height of +47.84 m and +37.69m respectively.

2.3 Common Facilities forPower Unit 1 and Power Unit 2:

In the Industrial area there are a good number of common facilities/objects to both the power units. The Common Plant Facilities include Demineralizing plant building (00UGD), Fresh fuel storage (00UFC), Health physics and personnel amenities building of the controlled access area (00UYB),Radioactive waste management facility(00UKS),Fire & technical water pumping station (03UGF), Sludge Dump with Clarified Water Pump Station (00UGR), Emergency communication facility, Switchyard Central Control Building (00UAC), Engineering and Personnel Amenities Building (00USV). All of these common plant facilities are in active construction phase and some of them are at the stage of completion of construction and erection works.

In case of 00UFC,the foundation works, concreting and installation works of contour walls, crane columnsand roof slabs have been completed. Presently, metalwork for ventilation pipe support, painting work and pipeline for sewerage network are in progress.This facility will be completely ready for receiving fresh fuel by August, 2023.

The foundation work, concreting of inner and outer wall (up to elev. +10.8) administrative unit and laboratory unit, concreting of slabs at differentelevations (elev.+9.6, elev. +10.8, elev. +14.6), installation of steel column and beam in industrial building and Painting of ceiling and walls of rooms of 00UGD have been completed. Presently, the Floor finishing work, architectural solution and Painting work of outer side are in progress. Preparation for commissioning of this facility is in progress.

In radioactive waste management facility (00UKS), foundation work, wallconcreting up to elev.+7.7m are completed. Presently, concreting of slab up to elev. +7.7m is ongoing.

In case of 00UYB, the Foundation work, concreting of shear wall and column up to +32.10 m and slab at +32.40 m are completed. At present, Plastering at Elevation +12.00 m, Brick work from +26.90m to +32.40m, Foundation concreting at elevation +22.700m are in progress.

For fire & technical water pumping station (03UGF), thefoundation work, concreting of shear wall up to elev. +6.25m,installation work of steel corrugated sheet from elev -.15m to elev.+7.3m, installation of heat insulation (rockwool) and installation of windows are completed. At present, 2nd layer painting work of inner site is in progress. In case of Engineering and Personnel Amenities Building (00USV), Reinforcement and concrete work of foundation slab at elev. -4.10m,concreting of basement wall and column at elev. -0.10m, concreting of the floor at elev. -0.10m and Column and slab (reinforced concrete structure) up to elev. +26.10m are completed. Presently, finishing work is being performed.

For switchyard central control building (00UAC),the foundation work, concreting of walls and columns and roof slab have been completed. Presently, brickworks, plastering and painting work are in progress.

The230-switchgearbuilding (00UAD**)** is conventionally divided into two parts: a one-storey part sized 76.5 x 15.5 m in plant with height of 17 m (top of the parapet) and a two-storey part sized 9.5 x 15.5 m with an elevation of floor slab top + 4.200; roof elevation +10.200 and height 15.6 m (top of the parapet). The foundation work, concrete and metal work up to roof have been finished. Presently, internal brick wall and painting work are ongoing.

The400 KV switchgear building (00UAB)is divided into two parts: one-storey part with dimensions in terms of 71.8 x 16 m and a height of 16 m (top of the parapet) and three-storey part with dimensions in terms of the axes x 12 16 m with the mark of the top floors +4.200; +8.400 and +12.600 coverage and height of 16 m (top of the parapet). The foundation work, concrete and metal work up to roof have been completed. The internal brick wall and painting work are ongoing.

Picture: Free Access Zone of Rooppur NPP

For the administrative building (00UYC),the foundation work (from elev. -4.7m to elev. -3.7m), Columns and slabs at different elevation and reinforced concrete structure up to elev. +33.900m and outer wall up to 7th floor are completed. Presently, finishing and brick laying works are going on.

For sludge dump with clarified water pump station (00UGR), land development and herbicides, polythene film, reinforced concrete slab at elev. +12.00(bottom) and top at elev. +19.50m, Open well work, inspector motorway / side road work, foundation of pump station of clarified water are completed. Presently, foundation of oil reservoir and fence work are in progress.

For diesel fuel and oil pump station (00UEL), Soil stabilization by deep soil mixing, excavation work from elevation 17.20 m to 18.90 m (Earth work = 31120 m3), concrete building foundations, column, walls and slabs and above-ground civil engineering structures screed concrete at floor and wall trowelling have been completed. Presently surface finishing is ongoing.

Picture: Water Intake Structure

In the firefighting machinery protection shed (00UYQ), civil works such as walls, columns, beams, slabs have been completed. Presently metal door installation is ongoing.

It is worth mentioning that under the foundation of all the facilities of industrial and common plant areas and also under the foundation of all safety class buildings/structures of the CEB-1 and CEB-2 areas, the special civil works under foundation successively (1) waterproofing of concrete bedding with 2 layers of Technoelastmost B, (2) the Concrete Building foundations and (3) more than 10-20 meter depth soil stabilization by deep soil mixing were performed.

2.4 Major Facilities at CEB-1 And CEB-2 Areas and Some Other Important Facilities in Industrial Area

Water Intake structureisdesigned and constructed to replenish irrecoverable losses of water from recirculating service water systems and also to ensure water supply for the process needs of the NPP. This system has many subsystems, namely protective spur (01UPC), shore protection (04UPC), intake channel (02UPC), fish protection facility (00UPX), water clarification chamber (03UPC), make-up pump station (01UGA) and filters chambers (02UGA). The foundation and concreting work of the wall of intake channel, clarification chamber, pump station andfilter chamber; the construction of sedimentation pit;installation of spacer bracing pipes and construction of coast protection spurhave been completed. Presently, installation of filter gates, internal pipelines, internal finishing of pump station, filter chamber, door and window installation, fire water, rainwater and sewage network and light post installation are in progress.

Picture: River Jetty

A cargo terminal and jetty have been constructed for transporting construction material and heavy equipment to the construction site. It has two areas: (1)general cargo area having open storage with related facilities and unloading heavy and oversized cargo with NPP equipment and (2)bulk cargo area having open storage area with related facilities for loading bulk cargoes for construction materials. These facilities are fully constructed and made functional for unloading equipment and construction material.

In addition, all other facilities of Rooppur NPP are in active construction phase. Some of the facilities are: building for firefighting water collection tank from building 10UJA (10 UGF), 3 Standby emergency power supply diesel power stations (11UBN, 12 UBN, 13 UBN), 3 Intermediate diesel storage (11UEJ, 12 UEJ, 13 UEJ), Unit pump station (10 URS), Pump Station(11-12 URF), Fire Fighting Station Structures (01UYP, 02UYP), Workshop of Common Access Area (00UST), Storage of Non-Combustible and Combustible Gas Cylinder (01-02 USK), Normal Operation System Cable Channel (08 UBZ), Essential Load Cooling System (11- 14 URB), Controlled-access area workshops (00UKU), Fire Fighting Machinery Protection Shed (00UYQ), Shielded center for managing emergency activities at the NPP (03UYX), Intake structure for diesel fuel and oils (01-07 UEH), Storage of Decontamination Facilities 01UXX, United Warehouse for Civil Defense Facilities (03UXX), The construction of civil defencefacilities for 600 person (01UYX) etc.

3. On-site Training Centre for Rooppur NPP

Necessary professional training has been arranged for about 1424 manpower including the reserve of305 person for operation and maintenance of Rooppur Nuclear Power Plant. So far 941 people of different categories have been recruited. Another 328 people are in the process of recruitment. To date, the initial stage training of approximately 640 manpower in the operation and maintenance of Unit-1 and Unit-2 has been completed in the Russian Federation. Rest of their on-the-job training will be completed by the Russian Federation through simulation of training centers set up in the project area. Already604 people have returned to Bangladesh after completing the training in Russian Federation. Currently36 trainees are undergoing training in Russian Federation.

Picture: Training Center

Rooppur NPP Training Center (TC) is an independent structural unit of Rooppur NPP. The main responsibility of the TC is the formation, maintenance and improvement of knowledge and

skills of the staff of Rooppur NPP for safe, trouble-free and reliable operation of Rooppur NPP. Rooppur NPP Training Center is a T-Shape multi-storied Building which consists of Theoretical Classroom, Practical Classroom, Simulator Room (including Full Scale Simulator and Analytical Simulator), Computer Based Training Systems (CBTS) Rooms, Administrative Office Room, Conference Room, Activity Hall, Canteen etc.

Total manpower required is 57. Existing Manpower is 34. There are 8 departments in the center, such as, (1) General Training Department (2) Operating Personnel Training Department (3) Maintenance & Repair Personnel Training Department (4) Full Scale Simulator Department (5) Training Methodology Department (6) Training Organization Department (7) Technical Training Means Operation Department (8) Administrative Service Department.

Picture: Analytical Simulator (AS)

Picture: Full Scale Simulator (FSS)

Full-scale simulator (FSS) is the largest simulator in Rooppur NPP Training Centre which is intended for simulation of the main and auxiliary process control of NPP with the use of full-scale model of real MCR (including Emergency Control Room, ECR) and integrated all-condition mathematical model of a plant operating in real time. The installation and commissioning activities of full-scale simulator and analytical simulators have been completed.

Moreover, other local simulators like; actions of personnel in the implementation of the plan for protection of personnel in case of radiation accident at the nuclear power plant (radiation safety), multifunctional interactive learning and training complex (fire safety), main electrical circuit simulator, and dismountable polygon for training to perform works at height have been completed their installation works. Now the Rooppur NPP Training Center (TC) is functioning on temporary basis.

4. Status of Rooppur NPP operating organization- NPCBL

Nuclear Power Plant Company Bangladesh Limited (NPCBL) has been incorporated as a Public Limited Company under the Companies Act 1994 and Nuclear Power Plants Act 2015 (Act No. XIX of 2015)].

The main objective of this company is to take over the operation and maintenance of Rooppur NPP after its construction and commissioning and to be engaged in the construction, commissioning, operation and maintenance of all other nuclear power plants to be built in the country in the future.The activities of the NPCBL are managed through an 11-member board of directors. The Senior Secretary of the Ministry of Science and Technology is the Chairman of the companyBoard and the Project Director, Rooppur NPP Project is the Member-Secretary of the board. The board also includes Additional Secretary (NP) of Ministry of Science and Technology, Additional Secretary of Finance Division, Additional Secretary of Power Division, Chairman of Bangladesh Atomic Energy Commission, Chairman of Bangladesh Power Development Board, Joint Secretary of Economic Relations Division, Joint Secretary ofLegislative and Parliamentary Affairs Division, Managing Director of Power Grid Company Bangladesh Limited and President of Federation of Bangladesh Chambers of Commerce & Industries as members.

Upto taking over the operation of the Rooppur NPP, the main activities of the NPCBL are limited to creating its infrastructure and proper manpower byrecruitment of employees of various levels and providing education

and training for their competency development.

In total about 2500 personnel are planned to be recruited and trained year by year for project management, commissioning and operation & maintenance at Rooppur NPP site and a small group will be working in the Headquarter of NPCBL. A total of 1424 key personnel (Licensing, Fuel-handling, Safety and Operational)will be trained by the Contractor (ASE JSC) in the frameworks of the General Contract, wherein 91 personnel will obtain licenses in compliance with Regulatory body; 1111 administrative and common industrial personnel, as well as general supporting staffs,will be trained in the On-site training centre of Rooppur NPP. Instructors of the training centre have been trained in Russian Federation under the General Contract.

A total of about 1020 officers and employees have already been appointed in the NPCBL. All of the officers and employees appointed for NPCBL have been engaged with the Rooppur NPP construction project for participation in the construction, erections, startup adjustment works and commissioning of power Unit 1 and Unit 2 along with General Constructor (ASE JSC) and its subcontractors' personnel.Among them, 658 personnel have been given higher training in Russian Federation. At present 84 trainees are being trained in Russia.

5. Manpower Development and Training Program

Title of the event	Date	Place	No of participants
Training for Rooppur NPP personnel according to the General Contract for Rooppur Nuclear Power Plant Construction	01 July 2021-30 June 2022	Russian Federation	261
Basic Training Program, Basic Course for VVER-type NPP	11 Oct -10 Nov, 2021	Rooppur NPP, Ishwardi	21
Basic Course on Maintenance & Repair for Rotating Equipment Division Group	14-18 Nov 2021	Rooppur NPP, Ishwardi	10
Basic Training Program, Basic Course for VVER-type NPP	28 Nov-23 Dec 2021	Rooppur NPP, Ishwardi	10
Basic Training Program, Basic Course for VVER-type NPP	17 April-26 may 2022	Rooppur NPP, Ishwardi	22
Practice in Full Scale Simulator: Startup of the Unit, Shutdown of the Unit, Practice of Malfunctions, Practice of Accidental Situations	22 May- 18 July 2022	Rooppur NPP, Ishwardi	8
Practice in Analytical Simulator (AS): Startup of the Unit, Shutdown of the Unit, Malfunctions and Accident Analysis	22 May- 17 June 2022	Rooppur NPP, Ishwardi	5
Nuclear and Radiological Emergency Preparedness	21 Nov- 02 Dec 2021	Training Institute, AERE	4
Training on Government office management and skill enhancement	1-5 Aug, 2021	Virtual	3

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

Name of the participant	Title of the event	Organizer	Date	Place
Dr. M. S. Akbar (invited speaker)	133rd Advanced Course on Administration and Development (ACAD) at BPATC	BPATC	3 Nov, 2021	BPATC
Dr. M. S. Akbar (keynote speaker)	Webinar on Nuclear Energy Technology for the Power System Evolution of Bangladesh to green and clean power	IEEE NSU PES SBC	29 April, 2021	Virtual
	Webinar on "New Alternative Fuel Sources for Bangladesh – Future Challenges"	BPMI	16 Oct, 2021	Virtual

Name of the participant	Title of the event	Organizer	Date	Place
N. Karim, M.G.S. Islam, M. A. Islam and M.S. Akbar	International Conference on Physics-2022	BPS	19-21 May, 2022	AECD, Dhaka
M. A. Amin, M. M. Rahman, M. G. S. Islam1, M. A. Islam, M. K. Hossain, M. Q. Huda and M. S. Akbar	International Conference on Physics-2022	BPS	19-21 May, 2022	AECD, Dhaka
S. A. Shumi, M. G. S. Islam, M. Moniruzzan, M. A. Islam, M. K. Hossain and M. Q. Huda	International Conference on Physics-2022	BPS	19-21 May, 2022	AECD, Dhaka
M. M. Rahman, M. Al-Amin, M. G. S. Islam, M. A. Islam, M. K. Hossain, M. Q. Huda and M. S. Akbar	International Conference on Physics-2022	BPS	19-21 May, 2022	AECD, Dhaka
Md. Ali Reza, Md. Rabiul Hassan, Md. Raihanul Haque, Md. Mizanur Rahman	International Conference on Physics-2022	BPS	19-21 May, 2022	AECD, Dhaka
Md. Al Amin, Md. Salah Uddin, Kazi Rakibul Islam, Md Alamgir Hossain	International Conference on Physics-2022	BPS	19-21 May, 2022	AECD, Dhaka
Md. Al Amin, Md. Salah Uddin, Kazi Rakibul Islam, Md Alamgir Hossain	International Conference on Physics-2022	BPS	19-21 May, 2022	AECD, Dhaka
N. N. Tonni and M. S. Akbar	International Conference on Physics-2022	BPS	19-21 May, 2022	AECD, Dhaka
S. Dey, M. A. Hassan, M. G. S. Islam, M. A. Islam and M. S. Akbar	International Conference on Physics-2022	BPS	19-21 May, 2022	AECD, Dhaka
	International Conference on Physics-2022	BPS	19-21 May, 2022	AECD, Dhaka
M. A. Mamun, M. Aliuzzaman, M. S. Ahsan, S. N. Sadia and M. S. Akbar	International Conference on Physics-2022	BPS	19-21 May, 2022	AECD, Dhaka
M. M. Rahman	International Conference on Physics-2022	BPS	15-20 May, 2022	AECD, Dhaka
N. Sultana, M. S. Ahsan and M. S. Akbar	International Conference on Physics-2022	BPS	15-20 May, 2022	AECD, Dhaka
M. S. Ahsan, N. N. Tonni and M. S. Akbar	International Conference on Physics-2022	BPS	19-21 May, 2022	AECD, Dhaka

7. Collaboration work/MoU

- BGD 2017: Developing Infrastructure and Support Systems for a Nuclear Power Plant During the various Stages of Construction-Phase II, Cycle 2020-2021
- BGD 2018: Developing Infrastructure for the First Nuclear Power Plant: Commissioning and Startup, Cycle 2020-2021.
- ADP: Construction of Rooppur Nuclear Power Plant Project. Year: 2021-2022

8. Others

- Coordinating national nuclear power infrastructure development activities for nuclear power program of this country.
- Organizing visits to Rooppur NPP construction site and presenting the construction activities to students,

academicians, decision makers and policy planners for practical realizations of NPP construction participating in stakeholders' involvement activities.

- Participating in national and international workshops, seminars, symposiums etc.
- Monthly Progress report submitted to Prime Minister's Office (PMO).
- Monthly Fast track report submitted to Economic Relations Division (ERD) & Ministry of Science and Technology (MoST).
- Monthly Financial Progress Report submitted to Implementation Monitoring and Evaluation Division (IMED).
- Monthly Report submitted to Bangladesh Atomic Energy Commission.

VI. NUCLEAR SAFETY, SECURITY AND SAFEGUARDS DIVISION (NSSSD), BAEC 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 BAEC facilities
- To maintain material accounting reports and declarations for BAEC facilities in accordance with the Comprehensive Safeguards Agreement
- To ensure the physical protection of nuclear material and radioactive sources and associated installations of BAEC
- On behalf of BAEC, this Division has been acting as the focal point of different well-known strategic partner namely International Atomic Energy Agency (IAEA), U.S. Department of Energy (U.S. DOE), Japan Atomic Energy Agency (JAEA), Forum for Nuclear Cooperation in Asia (FNCA) and Asia-Pacific Safeguards Network (APSN) for the issues of nuclear safeguards, safety, security and physical protection of radioactive materials and associated facilities.

Activities

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

Name of the participant	Title of the event	Organizer	Date	Place
Dr. M. S. Rahman	International Conference on Physics-2022	Bangladesh Physical Society	19-21 May 2022	AECD, Dhaka
	International Conference on Physics in Medicine	Bangladesh Medical Physics Association	26-27 May 2022	AECD, Dhaka
	Pre-shipment inspection of calibration X-ray machine at PTW-Freiburg, Germany under Establishment of Calibration and Quality Control Facilities for Radiotherapy, Diagnostic Radiology and Neutron Project	PTW, Germany	19-26 Nov. 2021	PTW, Germany
H. M. B. Alam	Review Meeting on ISSAS Mission in Bangladesh	BAERA	20-28 Mar. 2022	Dhaka, Bangladesh
	Preparatory Meeting and Training Workshop on ISSAS Mission	BAERA	01 Mar. 2022	Dhaka, Bangladesh
	International Conference on Electronics and Informatics 2021	BEIS	27-28 Nov. 2021	Dhaka, Bangladesh

2. Collaboration Work(s)

- NSSS Division has been working as the national focal point for Bangladesh's Integrated Nuclear Security Support Plan
- This Division has been continuing participation in the 'Nuclear Security and Safeguards Project' under the cooperation activities of FNCA

VII. PLANNING AND DEVELOPMENT DIVISION (PDD), BAEC HQ

Introduction

Planning and Development Division of Bangladesh Atomic Energy Commission is entrusted withthe responsibility of devising and processing development project plans for institutional advancement. Since its formation, the division has been the harbinger for achieving the far-reaching goals of achieving excellence in the nuclear science and technology sector of the country through the assessment, review, refinement, processing and submissionof research and development project proposals of BAEC. In tandem with the Perspective Plan 2021-2041adopted to build a developed and prosperous Shonar Bangla in 2041, the Eighth Five-yearPlan, as well as government's commitment to achieve Sustainable Development Goals (SDGs), PDD's paramount objective is to provide assistance in preparation, implementation and monitoringof development projects. In addition to that, PDD plays pivotal roleinfacilitating development ofskilled human resources in the science and technology sector. Apart from that, qualitative change in commission's activities is also intertwined in PDD's dominant objective.PDD frequently organizes trainings, workshops and seminars on E-Governance and 4th IR to accelerate people's access to services offered by BAEC and to promote scientists in innovation.

Activities

Planning and Development Division undertakes programmes which comprises assessment, review, refinement, and processing of development projects aimed at AnnualDevelopment Programme (ADP) and special allocation projects. In addition to that, PDDconducts administrative measures to forward Research and Development projects (R&D) and Science & Technology(S&T) projects to the line ministry.PDD also plays the role of superintendence and monitoring of R&D and S&T projects as per line ministry's directive. Incoherence with the programmes PDD frequently arranges different ADP project implementation committee meetings and assists organizing steering committee meeting.

The total RADP allocation of the year -2022 for implementation of ongoing projects of BAEC was Tk. 1524012.00 Lakh. Out of this granted allocation, Tk. 1391778.24 Lakh had been spent up to 30 June 2020 making an implementation rate of 91.32%.The entire picture on the advancement of all the development projects currently under implementation is depicted in the following table.

1. Advancement of the Development Project s under RADP

(Taka in lac)

Sl. No	Name of the project, implementation period	Estimated cost total (F.E)	Cumulative expenditure up to, Jun. 2021 (F.E)	Revised allocation for 2021-2022 (F.E)	Expenditure during 1 Jul. 2021- 30 Jun. 2022	Expenditure (%) against allocation up to 30 Jun. 2022	Achievement of the projects
1	2	3	4	5	7	9	10
	On-Going Projects						
1.	Construction of Rooppur Nuclear Power Plant, Apr. 2016 - Dec. 2025	11309291.28	4213495.83	1483639.00	1354446.31	91.29%	Ongoing
		10120000.00	31122.93	147879.00	147879.00	99.98%	
2.	Establishment of Institute of Nuclear Medicine and Allied Sciences (INMAS) at 8 Medical Collage Hospital	62228.80	15412.95	21235.00	21235.00	100%	Ongoing
		19520.00	12000.00	12000.00	12000.00	100%	

Sl. No	Name of the project, implementation period	Estimated cost total (F.E)	Cumulative expenditure up to, Jun. 2021 (F.E)	Revised allocation for 2021-2022 (F.E)	Expenditure during 1 Jul. 2021- 30 Jun. 2022	Expenditure (%) against allocation up to 30 Jun. 2022	Achievement of the projects
1	2	3	4	5	7	9	10
	Campuses in the country, Jul. 2017 - Jun. 2023						
3.	Establishment of Calibration and Quality Control Facilities for Radiotherapy, Diagnostic Radiology and Neutron, Jul. 2018 - Jun. 2023	4857.11	2412.50 1274.00	1374.00	1374.00	100%	Ongoing
		2893.11		1050.00	1050.00	100%	
4.	Establishment of Cyclotron & PET-CT at Institute of Nuclear Medicine & Allied Sciences (INMAS) Mymensingh & Chattogram and Cyclotron facilities at Institute of Nuclear Medical Physics (INMP), Savar, Jul. 2018 - Jun. 2023	70300.00	8134.25	7108.00	7108.00	100%	Ongoing
		33923.00	365.00	0	0	100%	
05.	Improvementand modernization of the laboratory Facilities of Institute of Electronics, Jul. 2018 - Dec. 2022	3553.70	1013.68 576.83	1910.00	1885.30	98.71%	Ongoing
		2102.50		1476.00	1476.00	99.80%	
06.	Balancing, Modernization, Refurbishment and Extension (BMRE) of Safety Systems of the 3 MW TRIGA Mark-II Research Reactor Facilityat AERE, Savar, Dhaka, Jul. 2018 - Jun. 2024	8543.58	1518.32 477.74	4635.00	4102.02	88.50% 99.75%	Ongoing
		4180.14		3550.00	3550.00		
07.	Screening of Congenital Hypothyroidism in Newborn Babies (Phase-2), Jul. 2018 - Jun. 2022	4770.16	3961.30 909.00	808.00	798.00	98.76%	Ongoing
		1119.00		210.00	210.00	100%	
08.	Strengthening of existing gamma source of Bangladesh Atomic Energy Commission Jan. 2021 - Jun. 2023	4670.00 4215.00	16.00 0	2552.00 2500.00	105.95 0	4.15% 99.95%	Ongoing
09.	Modernization and Strengthening of Services and Research Facilities of the Institute of Tissue Banking and Biomaterial Research Jul. 2021 - Jun. 2025	17380.14	0	527.00	525.91	99.79%	Ongoing
		1995.00	0	0	0	99.79%	

Sl. No	Name of the project, implementation period	Estimated cost total (F.E)	Cumulative expenditure up to, Jun. 2021 (F.E)	Revised allocation for 2021-2022 (F.E)	Expenditure during 1 Jul. 2021- 30 Jun. 2022	Expenditure (%) against allocation up to 30 Jun. 2022	Achievement of the projects
1	2	3	4	5	7	9	10
10.	Modernization of Laboratories and Enhancement of Service Capacity of 3 Divisions (Chemistry Division, Health Physics Division, Experimental Physics Division) of Atomic Energy Centre, Dhaka, Jul. 2021- Jun. 2024	4498.00	0	224.00	204.78	91.42%	Ongoing
		3112.00	0	0	0	99.89%	
	Total	11490091.98	4245964.83	1524012.00	1391778.24	91.32%	
		1089059.75		168665.00		99.98%	

2. Advancement of the Approved and Unapproved Development Projects under ADP

Sl. No	Name of the project, approval status and implementation period	Approval status	Estimated cost Total	Proposed ADP 2021-2022	Remarks
Proposed new project					
1.	Enhance Capacity of Institute of Nuclear Medicine and Allied Sciences (INMAS) at Mitford, Cumilla, Faridpur, Barishal and Bogura, July 2021 - June 2024	Unapproved	21479.00	0	Under processing for approval of ENEC.
			12801.00		
2.	Establishment of Institute of Nanotechnology, July 2021 - June 2024	Unapproved	38912.15	0	Awaiting approval from the Planning Commission.
			18208.00		
3.	Establishment of Genome Sequencing Facilities at NINMAS, Dhaka and INMAS, Chittagong, July 2021 - June 2023	Unapproved	4454.81 3298.80	0	Awaiting approval from the Planning Commission.

3. Manpower Development

Title of the event	Date	Place	No. of Participants
A Daylong Workshop on Innovation and Facilitating Services to Citizens	27 Dec. 2021	Alpha Hall	20
A Day-Long Workshop On E-Governance and Facilitating Services to Citizens	23 Jan. 2022	Alpha Hall	21
A Day-Long Workshop On E-Governance and Facilitating Services to Citizens	26 May 2022	Alpha Hall	13
Workshop On Disseminating Information on How to Deal withthelooming Challenges Of 4th Industrial Revolution	14 Jun. 2022	Alpha Hall	15
A Daylong Workshop On E-Governanceand Innovation in Facilitating Services to Citizens	23 Jun. 2022	Alpha Hall	18

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

Name of the Participant	Title of the Event	Organiser	Date	Place
Dr. S. M. Hossain	4th International Conference on Physics for Sustainable Development and Technology (ICPSDT-2022)	CUET	22-23 Jan. 2022	CUET
	The 9thMeeting of the Working Group on RCA Mid-Term Strategy Coordination	IAEA	21-23 Jul. 2021	Virtual Meeting
	The 10th Meeting of The Working Group on RCA Mid-Term Strategy Coordination	IAEA	2-4 Mar. 2022	Virtual Meeting
	Workshop on Feasibility Study for Development Project	BIM	20-21 Mar. 2022	BIM, Dhaka Campus
	TC Meeting on Final Coordination and Kick-off Virtual Meeting of New NST Education Project	IAEA	28 Mar. - 1 Ap. 2022	Virtual Meeting

5. Stakeholder Meeting

PDD is responsible for regularly coordinating BAEC projects' PIC meetings. Stakeholders of PDD include project directors and PIC members. The following is a summary of the PIC meetings-related material belonging to fiscal year 2021-22.

Date	place	Number of projects discussed
6 Sept. 2021	Alpha Conference Hall, BAEC	7
8 Dec. 2021	Alpha Conference Hall	8
17 Feb. 2022	Alpha Conference Hall	9
15 Jun. 2022	Alpha Conference Hall	9

6. Collaboration Work

Type of Collaboration	Name of the Institute	Date
MoU	Jagannath University (JnU)	9 Feb. 2022
MoU	Korea Atomic Energy Research Institute	25 May 2022

7. Others

- Convener and focal point of BAEC's "E-Governance and Innovation" team
- Convener of the Standing Committee formed to examine before the signing of the Memorandum of Understanding of Commission with the various countries of the world
- Vice Chair of "RCA Mid-term Strategy Coordination Group"
- Member of the Editorial Board of the BAEC's Journal of Nuclear Science and Applications
- Member of DPC-II of the Commission
- Member of Commission's Promotion Bio-Data Evaluation Committee-II
- Convenor of the Committee constituted on granting notional seniority to the officers of the Commission
- Member of the Committee constituted on grant of notional seniority to scientists/equivalent officers of the Commission

- Convener of the reconstituted committee to procuring stationery and printing items for various departments/branches of the head office of the commission and to verify/select the proposals and receive the goods as per the work order
- Member of the reconstituted Standing Committee on Works/Construction/Procurement under the Revenue budget and Projects of the Commission
- Member of Technical Committee on Draft Contract between Bangladesh Atomic Energy Commission and Joint Stock Company (The Russian Federation) for execution of works on construction of household and drinking water intake facility at Rooppur NPP construction site
- Convener of the committee formed to provide recommendations for employment in BAEC/NPCBL for the students who were sent to The Moscow Engineering Physics Institute of the National Research Nuclear University (MEPhI) in the academic year 2014-2021 of the Russian Federation and completed higher education
- Convener of the reconstituted committee regarding the proposal received from Agrani Bank, Shyamoli Branch, Dhaka for taking loan facility in favor of officers/employees of the Commission
- Member of the committee formed regarding the land claimed by SPARRSO on the campus of the Atomic Energy Research Establishment at Savar
- Member of the committee constituted for the examination of the DPP of the proposed project on the evaluation of the sites initially identified for the construction of nuclear power plants in the southern region of Bangladesh
- Member of the DPP Formulation Committee of the project titled "National Nuclear and Radiological Emergency Management and Environmental Radiation Research and Monitoring Centre"
- Convenor of the committee formed on the feasibility study of Bangabandhu Gamma Irradiator Center project proposed by Bangladesh Institute of Nuclear Agriculture
- Member of Senior Selection Committee regarding recruitment of Gas Transmission Company Limited (GTCL)
- Member of the Recruitment and Promotion Committee formed to provide recruitment and promotion to Grade-12 to Grade-5 posts of National Science and Technology Museum
- Member of Syllabus Formulation Committee of Department of Nuclear Engineering, Dhaka University
- Implementation of the ADP project titled "Capacity Building of Institute of Nuclear Medicine and Allied Sciences (INMAS) Dhaka, Chittagong, Rajshahi, Khulna, Sylhet, Dinajpur and Rangpur"; Project Director: Dr. Md Jahangir Alam, CSO, Planning and Development Department
- Implementation of the ADP project titled "Establishment of Institute of Nuclear Medicine and Allied Sciences (INMAS) in 8 Medical College Hospital Campuses of the country" is ongoing; Deputy Project Director: ASM Habibullah Khan, CSO, Department of Planning and Development

VIII. QUALITY MANAGEMENT DIVISION (QMD), BAEC HQ

Introduction

Like a few previous years Quality Management Division (QMD)continued itsdynamiccontributionto the implementation activities of RNPP Construction Project in the fiscal year of 20121-2022.Moreover, the Scientists of this Division were also involvedin some other tasks like updating "BAEC Service Regulations" in light of BAEC Service Regulations, 1985 and Bangladesh Atomic Energy Commission Act, 2017,Reviewing reports on "Technical Study Project to Establish High Power Research Reactor in Bangladesh" including Financial and Economic Analysis Report of HPMRR (both Bangla & English versions), Publishing research paper on IMS in BAEC,Preparing list of Project/Services/Research/Works etc. in BAEC from 2016-2021 to help prepare statistics on those activities to include it (statistics) in the ESCAP speech,Preparing and Submitting several reports on SDGs, Helping in preparing checklist for the "Inspection Committee for Citizen Charter Implementation", Helping in carrying out tasks and preparing working

documents and reports under activities of E-Governance & Innovation Team, Reviewing Research Paper, making comments on draft (open Science related) prepared by UNESCO, Updating Zilla Quota for BAEC employees under 14-20 Grades andperforming duties as other different Committee Members.

Activities

1.1 RNPP Construction Project Related Activities

- Performed duties as Incoming Control Inspection Team Member/Leader at Rooppur Nuclear Power Plant (RNPP) Construction Site for Long Term Manufacturing Equipment (LTME)and Non-LTME [(Supply Equipment (SU)]. In this fiscal year several Incoming Control Inspections at the site were carried out
- Performed duties as Member of the Joint Training Advisory Commission (JTAC) for conducting Manpower Training Programme and Developing Documents for NPP Training CentreforRooppur NPP Operating Personnel under Appendix 14 of General Contract
- Performed duties as Technical Committee Member for the Evaluation of Construction and Erection Works of Rooppur NPP
- Performed duties as Member of the Entry Level Test conduct committee for the training of Rooppur NPP Operating Personnel in Russian Federation
- Performed duties as Member of the committee formed to conduct knowledge assessment under qualification maintenance of the trainees who have returned after the completion of their training in Russian Federation as per Appendix-14 under General Contract
- Performed duties as Convener of the committee formed to inspect and audit sub-contractor organizations namely Bangladesh Building Systems Ltd. (BBSL) and Sonargaon Steel Fabricate Limited (SSFL) appointed by General Contractor JSC ASEwith regard to observance and compliance of quality of fabrication work, control and acceptanceof the work
- Performed duties as Convener of the committee formed to visit, inspect and audit sub-contractor organization namely Steelpac/Energypac PG Ltd., Confidence Infrastructures Limited, Modern Structures Limited and MEC Tech Corporation Limited appointed by Roin World S.L. a sub-contractor organization of the General Contractor JSC ASE to review, scrutinize and analyze their activities, to conduct incoming inspection, technological amenities, work execution plan etc. and to discuss about starting fabrication activities
- Actively involved in reviewing training documents including On-Job-Training Regulations as per Appendix-14 under General Contract
- Participated in several Milestone Achievement associated meetings
- Participated in several Equipment Specification related meetings
- Performed duties as a member of the Committee formed to prepare “Self-Assessment Report” with a view to arranging IAEA-pre-OSART mission
- Actively involved in reviewing documents regardingQAP (01), NPP-C-QAP, Regulations for Interactions/Quality/Commissioning related documents and RNPP Construction Project related documents
- Performed duties as a member of the Committee in relation to Nuclear Fresh Fuel Import
- Performed duties as Member of the committee formed in relation to LTME supply and Documentation package

1.2 Performing Duties as Other Different Committee Member

- Performed duties as a Member of the Editorial Board for the BAEC Journal of Nuclear Science & Applications
- Performed duties as Member of Departmental Promotion Committee-3 of BAEC
- Performed duties as Topical Group Leader of Safety Assessment for Asian Nuclear Safety Network (ANSN)

- Performed duties as Member of the Review Committee for the new Annual Development Project before submitting to the Ministry
- Performed duties as Member of the Evaluation Committee 1

1.3 Updating Zilla Quota for BAEC Employees under 14-20 Grades

Actively involved in updating Zilla Quota for BAEC employees under 14-20 Grades.

1.4 Updating "BAEC Service Regulations"

Actively engaged in updating "BAEC Service Regulations"in light of BAEC Service Regulations, 1985 and Bangladesh Atomic Energy Commission Act, 2017.

1.5 Reviewing Reports on "Technical Study Project to Establish High Power Research Reactor in Bangladesh"

Actively engaged in reviewing reports on "Technical Study Project to Establish High Power Research Reactor in Bangladesh" including Financial and Economic Analysis Reports of HPMRR (both Bangla & English versions).

1.6 Preparing and Submitting Several Reports on SDGs

QMD Scientist prepared and submitted the following SDGs related reports-

- Data for SDG Tracker
- Sustainable Development Goals (SDGs) Target Implementation Progress, Jul. 2021-Feb. 2022: (Both Bangla and English)
- Briefing on activities under BAEC in relation to SDGs for Budget Speech (2022-2023)
- Filled up Questionnaires with regard to preparing report on "Assessing the synergies and Trade-Offs among Sustainable Development Goals: The case of Bangladesh"

1.7 **Preparing Checklist for the "Inspection Committee for Citizen Charter Implementation"**

Helped in preparing checklist for the "Inspection Committee for Citizen Charter Implementation"

1.8 Helping in Carrying Out Tasks and Preparing Working Documents and Reports under Activities of E-Governance and Innovation Team

Actively engaged in carrying out tasks and preparing working documents and reports under activities of E-Governance & Innovation Team

1.9 Preparing list of Project/Services/Research/Works

Prepared list of project/services/research/works etc. in BAEC from 2016-2021 to help prepare statistics on those activities to include it (relevant BAEC Statistics) in the ESCAP speech.

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

Name of the participant	Title of the event	Organizer	Date	Place
Dr. M. Q. Huda	Joint Training Advisory Committee (JTAC) meeting related with Rooppur NPP operating personnel training programme	BAEC	16-27 Aug., 2021	Russian Federation
	Factory acceptance testing of Integrated Information System (IIS) of Rooppur NPP Training Center	BAEC	17-23, Oct., 2021	Russian Federation
	Audit Inspection of Rooppur NPP operating personnel training programme	BAEC	17-22, Feb., 2022	Russian Federation
	Joint Training Advisory Committee (JTAC) meeting and Hold Point Inspection	BAEC	27-30, Jun., 2022	Russian Federation

IX. SCIENTIFIC INFORMATION DIVISION (SID), BAEC HQ

Introduction

Scientific Information Division plays the key role to collect select, process and provide information to a wide range of stakeholders concerned with the R & D activities of BAEC. In addition, SID acts as an liaison between BAEC and the government on one hand and public, press etc on the other hand.

Activities

- Compilation, Editing and Publication of Scientific Journals, Periodical reports, Annual reports, Popular scientific articles, Brochure, Proceedings, Souvenir, leaflet, etc. related to R & D works of BAEC
- Collection, selection, processing for storage and dissemination of information in the field of scientific research and development of all branches of sciences
- Maintaining liaison with the News media, TV, Radio, etc. to disseminate news of scientific programmes, symposia, conference, seminar, workshop, training etc. under R & D and service activities of BAEC
- Updating information/documents in the website
- Selection, acquisition and distribution of Books, Journals, Calendar, Magazines, Annual report, Scientific News Letter and other scientific documents
- Processing nomination of BAEC scientists to attend various National Seminar, Symposium, Conference, Workshop etc.
- Processing nomination of BAEC Scientists for award at home and abroad
- Preparing reports and providing information for the National Assembly/Ministry of Science and Technology and other relevant government authorities relating to 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

Description of work	Quantity	Remarks
Publishing BAEC Annual Report 2019- 2020	300	Published, distributed and uploaded to the BAEC website *www.baec.gov.bd*
Arranging/Attending science fair/digital fair	1	Successfully completed
Publishing BAEC Diary 2021	1150	Published and distributed
Publishing telephone directory 2021 in Bangla	507	Published and distributed
Publishing Tender/Advertisement etc. to the newspaper	65	Published in the 110 daily newspapers
Newspaper clipping	311	Successfully completed
Press release on training, workshop conducted by BAEC and other BAEC programmes		Published in the daily newspapers
Photographic service (processed, printed and supplied)	4000	Distributed to the relevant divisions, organizations, etc.
Processed nominations of BAEC scientists to attend various scientific/technical/workshop/ seminar etc. arranged locally by different academic/professional institutes	17	Nomination letters were distributed to the relevant participants
Provide National Parliamentary questions and answers	1	Successfully completed
Provide Parliamentary Committee Report	4	Successfully completed

Description of work	Quantity	Remarks
Provide BAEC information for Preparation of Ministry Annual Report	3	Successfully completed
Preparation of annual performance agreement 2019-2020 between BAEC and MOST and Different Inst./Centre/ Unit with BAEC	48	Successfully completed
Preparing APA reports of BAEC	18	Successfully completed
Providing input for different bilateral contract/MoU/ international conference/meeting	2	Successfully completed
Preparing and providing opinions on the issues, acts, laws, etc.	19	Successfully completed
Preparing and providing monthly report to MOST	12	Successfully completed
Preparing and providing Election manifesto report to MOST	12	Successfully completed
Preparing and providing National Integrity Strategy (NIS) Report	3	Successfully completed
APA Report uploaded to APAMS of Cabinet Division	4	Successfully completed
Printing BAEC Annual Calendar 2020	2500	Successfully completed
Uploaded different programmes/video photographs in BAEC facebook	35	Successfully uploaded
Arranged Training Programme		Successfully uploaded

X. HUMAN RESOURCES DIVISION (HRD), BAEC HQ

Objective/Introduction

Human resource department is usually responsible for effectively managing anorganization's human resources, which are its employees, to achieve better performance.It also responsible for overseeing the policies and the relationship of the organization with its employees.This human resource management approach remains integral part ofany organization's core strategy and vision. It pursuesto optimize the development and the use of human resources for achieving the organizational goals. The strategic and philosophical contexts of human resource development and management make it more purposeful, relevant and effective compared to the traditional establishment approach.With these in view, the Human Resources Division (HRD) is launched in BAEC.The HRDivision is working directly under the Chairman of BAEC for the learning & developmentof its employeesas well asmanaging its human resources.

Activities/Programme(s)

1. Human Resource Development

The HRDivisiontakes necessary actioninnominating and developingthe organization's work force through employee training and career development mostly in national level which ultimately improves organizational effectiveness and performance. Within organizational level, the division assists and encouragesall institutesinarrangingspecialized training.

2. Human Resource Management: Human resource management is all about optimizing organization's performance through better management of its employeesusually using aHuman Resources Information System.Nevertheless, the HRD while neededtakes necessary steps and assists the authority bygiving critical opinion on employee related matters including enquiring charges against an employee for propermanagement.

3. Manpower Development and Training Programme

Title of theTraining	Date	Place	Participant
ইঞ্জিনিয়ারিং স্টাফ কলেজ, বাংলাদেশ (ইএসসিবি) কর্তৃক আয়োজিত বিভিন্ন বিষয়ে আইটি প্রশিক্ষণ কোর্স	1 Nov. – 31 Dec. 2021	ESCB, Dhaka	-
Public Procurement Management	25-28 Aug. 2021	BIM, Dhaka (Online)	-
Operations and Supply Chain Management (OSCM)	26-28 Aug. 2021	BIM, Dhaka (Online)	1
সরকারি নিরীক্ষা ও উন্নততর আর্থিক ব্যবস্থাপনা	26-27 Nov. 2021	BIM, Dhaka	-
উন্নয়ন প্রকল্প প্রক্রিয়াকরণ ও ব্যবস্থাপনা	27-30 Dec. 2021	Ministry of Planning	2
Advanced Certificate Course on Public Procurement & Project Management (1st Batch)"	2 Jan. -15 May 2022	BIM, Dhaka	3
ই-জিপি সিস্টেমে নিবন্ধিত ক্রয়কারী দপ্তর/সংস্থার কর্মকর্তাদের Procuring Entity (PE) Users	-	Ministry of Planning	2
Basic Principles of WTO Agreements and Notification Requirements	18-20 Jan. 2022	Ministry of Commerce	1
Online Office Management (25th Batch)	30 Jan. -10 Feb. 2022	BIM, Dhaka (Online)	1
Workshop of Delta Plan 2011	30 Jan. 2022	RPATC, Dhaka	1
Organization Admin এবং Policy Level (PL) কর্মকর্তাদের ‘‘ই-জিপি’’ বিষয়ে প্রশিক্ষণ	-	Ministry of Planning	1
তথ্য ও যোগাযোগ প্রযুক্তি বিষয়ক দীর্ঘ মেয়াদি ও স্বল্প মেয়াদি প্রশিক্ষণ	2 Feb. -30 Jun. 2022	BCC, Dhaka	-
Fundamental Training Course	6-24 Feb. 2022	RPATC, Dhaka	1
Conduct & Discipline Course	13-17 Feb. 2022	RPATC, Dhaka	1
Women in Leadership	23-24 Feb. 2022	BIM, Dhaka (Online)	4
Workshop of Annual Performance Agreement (APA)	24 Feb. 2022	RPATC, Dhaka	1
Oceanography: Principles and Application	26/2-14 May 2022	NOAMI	-
Blue Economy (2nd Batch)	6-10 Mar. 2022	NAPD, Dhaka	4
Modern Office Management Course	13-24 Mar. 2022	RPATC, Dhaka	1
Accounts Management for Staff & Executive	18-19 Mar. 2022	BIM, Dhaka	2
Feasibility Study for Development Project	20-21 Mar. 2022	BIM, Dhaka	7
e-Nothi Course	27-31 Mar. 2022	RPATC, Dhaka	1
Fundamental Training Course	03-28 Apr. 2022	RPATC, Dhaka	1
Communicative English Course	10-21 Apr. 2022	RPATC, Dhaka	1
Information and Communication Technology Course	29 May – 9 Jun. 2022	RPATC, Dhaka	1
Leveraging Technologies for Sustainable Development (3rd Batch)	22-26 May 2022	NAPD, Dhaka	3
e-Nothi Course	12-16 Jun. 2022	RPATC, Dhaka	1

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

Name of the Participant	Title of the event	Organizer	Date	Place
Dr. M. S. Ahmed	12th BAEC-JAEA Steering Committee Meeting (Nuclear HRD Programme in Bangladesh)	Bangladesh Atomic Energy Commission (BAEC) and Japan Atomic Energy Agency	31 Jan. 2022	Virtual Meeting

5. Collaboratio Work(s)

- The Ministry of Science and Technology (MoST) of the Government of the People's Republic of Bangladesh and the Ministry of Science and ICT of the Republic of Korea have signed a Memorandum of Understanding (MoU) on Scientific and Technical Cooperation. A joint committee is thus formed by the MoST for the implementation of the MoUin different areas of science & technology. Dr. Md. Shakil Ahmed, Director, HRD is assigned from BAEC as a member of this joint committee. The HRD is assisting different institutes of BAEC in preparing their proposals for the MoU.
- Director, HRD also worked as a team member of a high level committee formed by BAEC to rearrange and propose new honorarium and training allowances for Trainer, Trainee, Course Coordinator, Course Director, etc. of different training courses organized by Training Institute (TI), AERE, Savar, Dhaka.

6. Others

- Director, HRD is assigned as the Focal Point of BAEC for the development of an Integrated Digital Service Delivery Platform (IDSDP) for the Ministry of Science and Technology (MoST), Government of the People's Republic of Bangladesh. The Government is in the process of making all government services available digitally at the doorsteps of citizens in the form of electronics service. The goal of the platform is to transform traditional manual workflows into digital services and bring all citizen services of MoST and its organizations under one umbrella. Citizen centric services of BAEC like Testing, Analytical, Calibration, Consultancy and Health Services are meant to beavailable through this platform.

  The Focal Point with the cooperation of all members of the IDSDP Team of BAEC took all sorts of initiative related to IDSDP and made liaison with the MoST and the Software Development Company. The HR Division was also involved in preparing and sending monthly reports related to IDSDP activities of the BAEC Team.
- Director, HRD is also assigned as a Memberforvarious internal committees including Divisional Evaluation Committeeas well as a few external committees
- Sr. Administrative Officer, HRD is appointed as Member Secretary of the Innovation Team of BAEC. He assisted the Innovation Officer in organizing all meetings as well as trainings related to innovation in BAEC

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. The activities/involvements of SIU during the period under report are as follows:

- **Publication of AERE Technical Report, vol. 26:** The major documentation activity within the reporting period involves publication of the AERE Technical Report, vol. 26 by the SIU. The report covers the activities and achievements of AERE in 2020. The Unit has published a number of internal reports of different institutes/units of AERE.
- **Acquisition of Books and Journals:** In the period under report, the Unit collected 17 books of different titles to be used by the scientists/researchers of AERE.
- **Co-operation in Seminars/Symposia/Workshops held in AERE:** The Unit extended technical co-operation (photography) in documenting the seminars/symposia/workshops held in AERE
- **Attendance to Delegates/Visitors:** During the period under report the Unit had to host as many as 13 groups of delegates and visitors (comprising 411 visitors) from both home and abroad to AERE.

- **E-journal Service:** The Unit has been serving e-journals with the help of HINARI/AGORA/OARE from 2008. Users can download required articles from scientific books and journals from different publishers which are available in the internet.
- **Database Service:** The Unit provides on-line database and e-catalogue searching facilities.
- **Fax service:** Fax services are available at the Unit with the modern fax machine for receiving and sending official documents to and from AERE.
- **Current Awareness Service (CAS) and Selective Dissemination Service (SDS):** Books/journal's etc. are listed on the basis of recent collections to inform the scientists and researchers at AERE.
- **News Clipping Compilation and Preservation:** News concerning Bangladesh Atomic Energy Commission (BAEC), Rooppur NPP project and in general nuclear science and technology published in daily newspapers are clipped to the Notice Boards of different institutes/units of AERE for dissemination and awareness of scientists of AERE.
- **Routine Services:** The routine services rendered during the period under report includes (i) photography and documentation service in different national day ceremonies/programmes (ii) photographic service to the officials/employees of AERE for official purpose and (iii) reprography service etc.

The SIU has always been trying to perform all the assigned duties and responsibilities accordingly and timely and is going smoothly to achieve the target.

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. Besides this, now-a-days different types of radiation sources are being used in different sectors in our country especially for medical, industrial, research and development purposes. Considering all these necessities TI is conducting different kinds of training programmes round the year as per the approval of BAEC.

Activities

1. Manpower Development and Training Programme

Title of the Event	Date	Place	No. of participants
Training on Radiation Protection for Radiation Workers and RCOs of BAEC, Medical Facilities & Industries	24-28 Oct. 2021	TI, AERE	34
FTC on Nuclear and Radiological Emergency Preparedness Course at BAEC	21 Nov- 02 Dec, 2021	TI, AERE	20
In-house training Course on General Behaviour and Office Rules	21-23 June, 2022	TI, AERE	37

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

Name of the participant	Title of the event	Organizer	Date	Place
Dr. A. K. Das	Meeting of Joint Training Advisory Commission with Russian Counterparts	HRD, RNPP	12-16 Sept. 2021	Rooppur Pabna
		HRD, RNPP	05-09 Dec. 2021	Rooppur Pabna
		HRD, RNPP	26 Dec. 2021	Rooppur Pabna
	Joint Committee Meeting with Indian Counterparts	HRD, RNPP	9-12 May 2022	Inter-Continental Hotel, Dhaka
	JTAC Meeting for acceptance of Full Scale Simulator (FSS) for NPP	HRD, RNPP	9 Jun. 2022	Rooppur Pabna
	Workshop on 4th Industrial Revolution.	PdD, BAEC	14 Jun. 2022	Rooppur Pabna
	Meeting of Joint Training Advisory Commission (JTAC) with Russian Counterparts	HRD, RNPP and JSC Atomstroy-export, Russia	27 Jun. -3 Jul. 2022	Moscow, Russia
M. Hossain	Workshop on e-Governance & Public Service Innovation	BAEC HQ	26 May 2022	BAEC, HQ
M. I. Chowdhury	Training on "Right to Information, Grievance Redress System (GRS), Software & Service Delivery Commitment.	BAEC HQ	06 Jun. 2022	BAEC, HQ

3. Lecturer Delivered

Dr. Ananda Kumar Das has delivered a series of Lecture on i) Basics of Radiation Physics, ii) Nuclear and Radiological Emergency Preparedness iii) Disaster Management (Bangladesh Perspective) iv) National Integrity Strategy of Bangladesh and vii) Good Practices etc. in the Follow-up Training Courses and other courses arranged in TI within 2021-22 fiscal years.

4. Provided Logistic Support

Title of the Event	Date	Place	No. of Participants
Technical Workshop on a2i, Host: MoICT	19-20 Oct. 2021	TI	20

5. Service Rendered and Revenue Income

Type of service	Revenue income
Dormitory Rent	67,400/-
Course Fee	90,000/-
Total	1,57,400/-

XIII. FINANCE AND ACCOUNTS DIVISION (FAD), BAEC HQ

Activities

1. Revenue Budget Allocation, Fund Release and Source of Fund

(Taka in lac)

Code	Head of Accounts			
		Allocation from Govt.	**Received from BAEC own income**	**Total Revenue Budget**
3631101	Salary Support	8812.00	----	4412.00
3631102	Allowance Support	7261.84	----	7261.84
3631103	Goods and Service Support (With Service Charge)	2752.16	6035.26	8787.42
3631104	Pension and Retirment Support	4569.00	----	4569.00
3631108	Research Grant	300.00	103.00	403.00
3631199	Others Grant	295.00	---	295.00
	Sub-Total	23990.00	6138.26	30128.26
3632102	Machinaries Grant	615.00	215.50	830.50
3632104	Building & Structure Construction Grant	182.00	248.00	430.00
3632105	Information and communication Tecnology Grant	55.00	19.50	74.50
3632106	Others Capital Grant	40.00	107.00	147.00
	Sub-Total	892.00	590.00	1482.00
	Total	24882.00	6728.26	31610.26

2. Center/Institute Wise Revenue Budget Allocation

(Taka in lac)

Name of the Centre/Institute	Revenue Budget Allocation
BAE.C, Head Quarter, Dhaka	3363.84
Works Branch, B.A.E.C. Dhaka	1925.24
B.A.E.R.A. Dhaka	417.00
Atomic Energy Centre, Dhaka	2606.00
AERE, Savar	6877.00
National Institute of Nuclear Medicine & Allied Sciences, Dhaka	1158.00
Institute of Nuclear Medicine & Allied Sciences, Chattogram	320.00
Institute of Nuclear Medicine & Allied Sciences, Rajshahi	336.00
Institute of Nuclear Medicine & Allied Sciences, Dinajpur	225.00
Institute of Nuclear Medicine & Allied Sciences, Sylhet	199.00
Institute of Nuclear Medicine & Allied Sciences, Dhaka	614.00
Institute of Nuclear Medicine & Allied Sciences, Barishal	242.00
Institute of Nuclear Medicine & Allied Sciences, Khulna	293.00
Institute of Nuclear Medicine & Allied Sciences, Rangpur	363.00
Institute of Nuclear Medicine & Allied Sciences, Mymensing	492.00
Institute of Nuclear Medicine & Allied Sciences, Bogura.	335.00
Institute of Nuclear Medicine & Allied Sciences, Cumilla	233.00

Name of the Centre/Institute	Revenue Budget Allocation
Institute of Nuclear Medicine & Allied Sciences, Faridpur	252.00
Institute of Nuclear Medicine & Allied Sciences, Midford	340.00
Institute of Nuclear Medicine & Allied Sciences, Cox's Bazar	135.00
Atomic Energy Centre, Chattogram	302.00
BSMEC, Cox's Bazar	156.00
RNPP, Pabna	135.00
RTML, Mongla	93.00
Foreign Exchange Branch, BAEC, Dhaka	2043.50
Pension & retirment benefit Branch, BAEC, Dhaka	4569.00
Service Charge Branch, BAEC, Dhaka	2484.18
Reserve for return to Gov. fund)	1101.50
Total	31610.26

XIV. SUPERVISION OF THESIS

ATOMIC ENERGY CENTRE (AEC), DHAKA

Chemistry Division, AECD

1. Joint-supervision: Dr. Shamshad Begum Quraishi, "Assessment of heavy metals in soil and vegetables: associated human health and ecological risks", M. Sc. Thesis (Booshra Ahmed), Department of Environmental Science, Bangladesh University of Professionals, 2021.
2. Joint-supervisor: Dr. Yeasmin Nahar Jolly, "Heavy metals in coastal wetland sediment of Bangladesh: levels, source and toxic risks", M.Sc. Thesis (Jakia Sultana), Department of Fisheries and Marine Science, Noakhali Science and Technology University, submitted, Dec., 2021.
3. Joint-supervisor: Dr. Yeasmin Nahar Jolly, "Analysing the groundwater quality of Savar tannery estate in Hemayetpur", B.Sc. Thesis (Jakia Sultana), Department of Environmental Science, Bangladesh University of Professionals, Feb., 2022.
4. Joint-supervisor: Dr. Yeasmin Nahar Jolly, "Heavy metal contamination on soil, water, plants and fishes around some industrial areas of Bangladesh and its impact on human health and environment", M.Sc. Thesis (Arefa Ferdous Ruma), Department of Soil, Water and Environment, University of Dhaka, submitted, Jun., 2022.
5. Joint-supervisor: Dr. Yeasmin Nahar Jolly, "Impact of solid waste with special emphasis on heavy metals on surrounding environment of Amin Bazar landfill site, Dhaka, Bangladesh", M.Sc. Thesis (Ishrat Jahanara Maya), Department of Soil, Water and Environment, University of Dhaka, submitted, Jun. 2022.
6. Joint- supervisor: Dr. Bilkis Ara Begum, "Seasonal variation of $PM_{2.5}$ and black carbon and source apportionment of $PM_{2.5}$ by using backward trajectory approach", M.Sc. Thesis (Md. Kamrul Hasan), Geography Department, Noakhali Science and Technology University, 2022.
7. Joint-supervision: Dr. Bilkis Ara Begum, "Source determination and seasonal variation of PM_{10}, $PM_{2.5}$ and black carbon and their chemical composition in semi-residential and industrial area of Dhaka city", M.Sc. Thesis (Md. Jahidul Islam), Environmental Science Department, Jahangirnagar University, 2022.
8. Joint- supervisor: Dr. Md. Safiur Rahman, "Concentration and human health risk assessment of heavy metals in soil, water and some food stuffs from the proposed site of Ruppur Nuclear Power Plant, Bangladesh", Ph. D. Thesis (Md. Mahatab Ali), Applied Chemistry and Chemical Engineering Department, University of Rajshahi, 2022.
9. Joint- supervisor: Dr. Md. Safiur Rahman, "Fabrication of nano filter composites of graphene oxide (GO) and banana rachis cellulose nano crystal (CNC) and their filtering efficiency", M.Sc. Thesis (Md. Shamim Sheikh), Applied Chemistry and Chemical Engineering Department, Islamic University, Kushtia, 2022.
10. Joint- supervisor: Dr. Md. Safiur Rahman, "An investigation of trace heavy metal concentrations in the street dust samples collected from roadside building wall in Rajshahi City, Bangladesh", M.Sc. Thesis (Md. Sad-E-SakibSarker), Applied Chemistry and Chemical Engineering Department, Rajshahi University, 2021.
11. Joint-supervision: Dr. Md. Safiur Rahman, "Health risk assessment of toxic metals in the road side soil in Rajshahi City, Bangladesh", M.Sc. Thesis (Md. Masud Rana), Applied Chemistry and Chemical Engineering Department, Islamic University, Kushtia, 2022.
12. Joint-supervisor: Dr. Tasrina Rabia Choudhury, "Heavy metal contamination and health risk assessment of road dust from landfills in Dhaka and Narayanganj", M.Sc. Thesis (Mrittika Chakraborty), Department of Chemistry, University of Dhaka, Feb.2022.
13. Joint-supervisor: Dr. Tasrina Rabia Choudhury, "Vertical distributional profile and ecological risk assessment of heavy metal in sediment cores of passur river adjacent to the world's largest mangrove forest", B.Sc.(Hons) Thesis (Md. Rakibul Hasan), Department of Fisheries and Marine Science, Noakhali Science and Technology University, Noakhali, Bangladesh, Mar. 2022.

14. Joint-supervisor: Dr. Tasrina Rabia Choudhury, "Contamination and ecological risk assessment of heavy metals in sediments of two major sea ports, Bangladesh", B. Sc (Hons) Thesis (Md. Yeamim Aftad), Department of Fisheries and Marine Science, Noakhali Science and Technology University, Noakhali, Bangladesh, Mar. 2022.
15. Joint-supervisor: Dr. Tasrina Rabia Choudhury, "Bioaccumulation of heavy metals in tissues of cultured and wild seabass, and associated human health risks", B.Sc. (Hons) Thesis (Tanha Tahiti), Department of Fisheries and Marine Science, Noakhali Science and Technology University, Noakhali, Bangladesh, Mar. 2022.
16. Joint-supervisor: Dr. Tasrina Rabia Choudhury, "Human health and ecological risk assessment of heavy metals in cultured shrimp and aquaculture sludge", B.Sc. (Hons) Thesis (Salma Sultana), Department of Fisheries and Marine Science, Noakhali Science and Technology University, Noakhali, Bangladesh, Mar. 2022.
17. Joint-supervisor: Dr. Tasrina Rabia Choudhury, "Microplastic contamination in food grade sea salt from Bangladesh", M.Sc. Thesis (As-Ad Ujjaman Nur), Department of Fisheries and Marine Science, Noakhali Science and Technology University,Noakhali, Bangladesh, Feb. 2022.
18. Joint-supervisor: Dr. Tasrina Rabia Choudhury, "Assessment of heavy metal residues contamination in chicken meats, eggs and poultry feeds available in Hemayetpur, Savar", M.S. Thesis (Faria Jahan), Department of Environmental Science, Bangladesh University of Professionals (BUP), Jun. 2022.
19. Joint-supervisor: Dr. Tasrina Rabia Choudhury, "Diagnosis of environmental health at a deltaic mangrove ecosystem: a case study for Sundarbans mangrove forest, Bangladesh", B.Sc. (Hons) Thesis (Sheikh Fahim Faysal Sowrav), Department of Oceanography and Hydrography, Bangabandhu Sheikh Mujibur Rahman Maritime University, Bangladesh, Jan. 2022.
20. Joint-supervisor: Dr. Tasrina Rabia Choudhury, "Analysis of heavy metal concentration of the coral ecosystem in Bangladesh to evaluate the ecotoxicity & ecological health", B.Sc. (Hons) Thesis (Kashafad Bin Hafiz), Department of Oceanography and Hydrography, Bangabandhu Sheikh Mujibur Rahman Maritime University, Bangladesh, Jan.2022.
21. Joint-supervisor: Dr.Sushmita Hossain, "Assessing sedimentological and diagenetic controls on reservoir quality of the fluvio-deltaic Miocene Surma Group deposits based on core sample analysis of Fenchuganj Well 02", MS. Thesis (ZuanaAlom), Department of Geology, University of Dhaka.
22. Joint-supervisor: Md. Nur E Alam, "Trace metals concentration, quality indices, pollution sources, bio-accumulation and health risk assessment: water and fish from Kaptai lake, Rangamati", M.Sc. Thesis (Dipto Das), Department of Applied Chemistry and Chemical Engineering, University of Chittagong, Bangladesh.

Health Physics Division, AECD

23. Joint-supervisor: Selina Yeasmin, "Assessment of radioactivity in soil and sediment samples collected from Buriganga and Turag river in Bangladesh", B.Sc. Thesis (Tonmay Chowdhury), Department of Nuclear Engineering, University of Dhaka, Feb. 2022.
24. Joint-supervisor: Selina Yeasmin, "Measurement of radioactivity in soil samples collected around Savar, Narayanganj and Dhamrai in Bangladesh", B.Sc. Thesis (Mir Dider Ali Rakib), Department of Nuclear Engineering, University of Dhaka, Feb. 2022.
25. Joint-supervisor: Selina Yeasmin, "Background radiation survey and measurement of radioactivity & radiological hazards in soil samples collected around Dhaka city", B.Sc. Thesis (Tanvir Alam Alif), Department of Nuclear Engineering, University of Dhaka, Feb. 2022.
26. Joint-supervisor: Selina Yeasmin, "Measurement of radioactivity concentration in commercially available bottled water and evaluation of the associated effective dose", B.Sc. Thesis (Jubair Al Mahmud), Department of Nuclear Engineering, University of Dhaka, Feb. 2022.
27. Joint-supervisor: Selina Yeasmin, "Assessment of radioactivity concentration and radiological hazards in the polluted Buriganga river water and tap water of the megacity Dhaka", B.Sc. Thesis (M. Shafiqul Alam), Department of Nuclear Engineering, University of Dhaka, Feb. 2022.

28. Joint-supervisor: Selina Yeasmin, "Assessment of radioactivity and radiological hazard in soil and water sample collected from Bhola 225 MW combined cycle power plant, Borhanuddin, Bhola, Bangladesh", M.S. Thesis (Madhurja Sarker), Department of Nuclear Engineering, University of Dhaka, Mar. 2022.
29. Joint-supervisor: Selina Yeasmin, "Assessment of radioactivity and radiological hazard in soil sample collected from Bandarban, Bangladesh", M.S. Thesis (Debasish Roy), Department of Nuclear Engineering, University of Dhaka, Mar. 2022.
30. Joint-supervisor: Selina Yeasmin, "Determination of radioactivity concentration, transfer factor from soil to rice of Jashore District, Bangladesh and associated health hazards assessment", M.Sc. Thesis (Laisee Lubna), Department of Nuclear Engineering, University of Dhaka, Feb. 2022.
31. Joint-supervisor: Selina Yeasmin, "Measurement of natural and artificial radioactivity in different raw milk samples collected from different locations of Dhaka City and corresponding health hazard using gamma ray spectrometry system", B.Sc. Thesis (Md. Minhaz Kabir), Department of Nuclear Engineering, University of Dhaka, Feb. 2022.
32. Joint-supervisor: Selina Yeasmin, "Study of environmental radiation and radioactivity on sand samples and associate health hazards collected from different locations of gorai-modhumoti river near Rooppur Nuclear Power plant using gamma-ray spectrometry system", B.Sc. Thesis (Md. Jafor Ali), Department of Nuclear Engineering, University of Dhaka, Feb. 2022.
33. Joint-supervisor: Selina Yeasmin, "A study of natural radionuclide concentrations in soil and water samples at Banshkhali upazilla in Chittagong district, Bangladesh", M.Sc. Thesis (M. J. Farid), Department of Physics, University of Chittagong, Apr. 2022.
34. Joint-supervisor: Dr. Mohammad Sohelur Rahman, "Real-time radiation monitoring around three hospital campuses in Dhaka and evaluation of radiological risk on public health by in-situ method", M.S. Thesis (Md. Arman Ali), Department of Physics, Jahangirnagar University, Nov. 2021.
35. Joint-supervisor: Dr. Mohammad Sohelur Rahman,"Real-time radiation monitoring around BIRDEM hospital campus by in-situ method", M.S. Thesis (Sk. Sabbir Ahmed Shakil), Department of Physics, JU, Nov. 2021.
36. Joint-supervisor: Dr. Mohammad Sohelur Rahman, "Assessment of Environmental Impact from the Atomic Energy Centre Dhaka", M.S. Thesis (Ashraf), Department of Physics, JU, Nov. 2021.
37. Joint-supervisor: Dr. Mohammad Sohelur Rahman, "Real-time environmental gamma radiation monitoring in Dhanmondi thana following in-situ method", M.S. Thesis (Esrat Zahan), Department of Physics, MBSTU, Jun. 2022.
38. Joint-supervisor: Dr. Mohammad Sohelur Rahman, "Radiation monitoring around two large hospital campuses by in-situ method and estimation of radiation risk on public", M.S. Thesis (Salma Akter), Department of Physics, MBSTU, Jun. 2022.
39. Joint-supervisor: Dr. Mohammad Sohelur Rahman, "Assessment of environmental impact from radiological facility", M.S. Thesis (Omar Faruk), Department of Physics, MBSTU, Jun. 2022.
40. Joint-supervisor: Dr. Mohammad Sohelur Rahman, "Indoor radiation monitoring using thermoluminescent dosimeters and estimation of radiation risk on worker & public at Shahbag thana in Dhaka city", M.S. Thesis (Shirajum Munira), Department of Physics, JU, Apr. 2022.
41. Joint-supervisor: Dr. Mohammad Sohelur Rahman, "Real-time radiation monitoring around Rangpur medical college hospital and Chittagong medical college hospital by in-situ method", M.S. Thesis (Arun Chowhan), Department of Physics, JU, Jun. 2022.

Materials Science Division, AECD

42. Co-supervisor: Dr. Mohammad Nazrul Islam Khan, "Synthesis & characterization of ag doped $ZnFe_2O_4$ nanoparticles in solar cell application. $Zn_{1-x}Ag_xFe_2O_4$[x=0.0,0.1,0.2,0.3,0.4] ", M.Sc. Thesis (RabeyaBosri), Department of Physics, Cumilla University, Sept. 2021.
43. Co-supervisor: Dr. Mohammad Nazrul Islam Khan, "Synthesis and characterization of europium doped nickel zinc cobalt ferrite", M.Sc. Thesis (Imran Sardar), Department of Physics Khulna University, Sept. 2021.

44. Co-supervisor: Dr. Engr. Sheikh Manjura Hoque, "Devolopment and characterization of cellulose based food package coated with chitosan and containing TiO_2 and Ag/TiO_2 nanoparticles", M.S. Thesis (Sourav Kumar Singha), Department of Food Technology and Rural Industries Bangladesh Agricultural University, Mymenshingh, Dec. 2021.
45. Co-supervisor: Dr. Engr. Sheikh Manjura Hoque, "Development of nanohydeoxyapatite-chitosangelatin scaffolds the analysis of osteoblast in rabbit model (in vivo)", M.S. Thesis (PremanandaDas), Department of Surgery and Obstetrics Bangladesh Agricultural University, Mymenshingh, Dec. 2021.
46. Co-supervisor: Dr. Engr. Sheikh Manjura Hoque, "Incorporation of $CoFe_2O_4$ nanoparticles in chitosan-PEG scaffold for enhanced wound healing", M.S. Thesis (Munira Dilshad), Department of Applied Chemical Engineering University of Dhaka, Mar. 2022.
47. Co-supervisor: Dr. Engr. Sheikh Manjura Hoque, "PEGylation of $Mg_xCo_{1-x}Fe_2O_4$ nanoparticles and their conjugation with doxorubicin for a comparative study of drug loading and drug release in hyperthermia based anticancer drug delivery process", M.S. Thesis (Sadia Hossain), Department of Physics,University of Dhaka, Mar. 2022.
48. Co-supervisor: Dr. Engr. Sheikh ManjuraHoque, "Dextran coated magnetic $Co_xMg_{1-x}Fe_2O_4$ nanoparticles: study of drug release capacity in hyperthermia-triggered anti-cancer drug delivery", M.S. Thesis(Tamanna Hoque), Department of Physics, Dhaka University, Mar. 2022.
49. Co-supervisor: Dr. Engr. Sheikh ManjuraHoque,"An on-site review on nanomaterials synthesisthrough chemical methodology and novel characterizations for biomedical applications", Training (AmitraHoq), Department of Biological Sciences New York University, New York, Mar. 2022.
50. Co-supervisor: Dr. Engr. Sheikh ManjuraHoque,"Synthesis of novel magnetite nanoparticles with chitosaanmesoporoussilica coating for efficient removal of heavy metals from wastewater", M. Sc. Thesis (Kazi Faiza Amin), Department of Pharmacy, North South University, May 2022.

Medical Physics Division, IFRB

51. Co-supervisor: Dr Rajada Khatun, "Commissioning of radiotherapy treatment planning system using CIRS thorax phantom: optimization of the dosimetric test of the IAEA TECDOC-1583 guidelines" M.Sc Thesis (Shoorjo Islam Khan), Department of Medical Physics and Biomedical Engineering, Gono Bishwabidyalay, Nov. 2021.
52. Co-supervisor: Dr Rajada Khatun, "Evaluation of dosimetric errors of TPS calculations for lung doses in 3D-CRT & IMRT using CIRS thorax phantom", M.Sc Thesis (Sultan Mahmud), Department of Medical Physics and Biomedical Engineering, Gono Bishwabidyalay, Nov. 2021.

INSTITUTE OF RADIATION AND POLYMER TECHNOLOGY (IRPT), AERE

53. Supervisors: Md. Serajum Manir, "Synthesis and characterization of Mxene-BiOI-MoS_2-based ternary nanocomposite for photo-catalytic application", M.S. Thesis (Md. Mofakkharul Hasan), Department of Chemistry, Hajee Mohammad Danesh Science & Technology University, session: 2020.
54. Supervisor: Md. Serajum Manir, "Green Synthesis of metal oxide nanoparticle and its application in photo-catalysis", M.S. Thesis (Umme Khayer Salma), Department of Chemistry, Hajee Mohammad Danesh Science & Technology University, session: 2020.
55. Supervisor: Md. Serajum Manir, "Extraction, optical properties and ageing effect of natural dyes and its impact on the power conversion efficiency of dye-sensitized solar cells", M.S. Thesis (Syeda Jafri Shahrin), Department of Electrical and Electronic Engineering, Premier University, Chittagong, session: 2020.

INSTITUTE OF NUCLEAR SCIENCE AND TECHNOLOGY (INST), AERE

Nuclear Radiation and Chemistry Division, INST

56. Supervisor: Dr. Salma Sultana, **"**Preparation and characterization of gamma radiation assisted chitosan/4-styrene sulfonic acid based hydrogel and application for methylene blue dye removal", B.Sc.Hons (Israil Evan), Department of Chemistry, University of Barishal.

57. Supervisor: Dr. Nazia Rahman, "Radiation grafting of polymers for advanced applications", M. Phil. Thesis (Md. Sohel Rana), Department of Chemistry, University of Dhaka, submitted on Nov. 2021.
58. Joint-supervisor: Farah Tasneem Ahmed, "Human health risk assessment of surface water, ground water near DEPZA area, savar, Dhaka", B. Sc. (Engineering) (Nasim Ahmed), Department of Chemical Engineering, Jashore University of Science and Technology, Jul., 2020.
59. Joint-supervisor: Farah Tasneem Ahmed, "Effects of kitchen compost, quick compost and biochar on the transfer of Cd from a seasonally flooded sandy loam soil to Red amaranth (Amaranthuscruentus)", M. Sc. Thesis (Reyad Hossain Arif), Department of Environmental Science and Resource Management, MawlanaBhasani Science and Technology University, Dec., 2020.
60. Joint-supervisor: Farah Tasneem Ahmed, "Determination of Cd, Pb, Cr, Cu, Zn and Ni in liver and kidney of cows and bulls and its' health risk assessment", M. Sc. Thesis (Md. Kabir Hossen), Department of Environmental Science and Resource Management, MawlanaBhasani Science and Technology University, Dec., 2020.
61. Joint-supervisor: Farah Tasneem Ahmed, "Heavy metal pollution and assessment of health risk from road sideagricultural land nearly Dhaka-Aricha highway", M. Sc. Thesis (Saiful Islam), Department of Environmental Science and Resource Management, MawlanaBhasani Science and Technology University, Apr., 2021.

Reactor and Neutron Physics Division, INST

62. Joint-supervisor: Dr. Mohammad Amirul Islam, "Assessment of natural radioactivity levels and radiological hazards in sediments of the Atrai river, Bangladesh", M.Sc. Thesis (Md. Ashraful Islam), Department of Physics, Hajee Mohammad Danesh Science & Technology University, Dinajpur, 2022.
63. Joint-supervisor: Dr. Rahat Khan, "Determination of elemental concentrations of soil samples using neutron irradiation and gamma spectroscopy, and comparison with coal samples", B.Sc. Thesis (MD. Yasin Ahmed Sheikh), Department of Nuclear Engineering, University of Dhaka, Bangladesh, 2021.
64. Joint-supervisor: Dr. Rahat Khan, "Determination of elemental concentrations in coal samples of jamalganj using neutron irradiation and gamma spectroscopy", B.Sc. Thesis (Anik Sarker), Department of Nuclear Engineering, University of Dhaka, Bangladesh, 2022.
65. Joint-supervisor: Dr. Rahat Khan, "Determination of elemental compositions in coal samples of Jamalganj coal field using neutron activation analysis and gamma spectroscopy", M.Sc. Thesis (Nazmul Islam), Department of Nuclear Engineering, University of Dhaka, Bangladesh, 2022.
66. Joint-supervisor: Dr. Rahat Khan, "Environmental and ecological appraisal of a transboundary river of Bangladesh (Punarbhaba) from instrumental neutron activation analysis (INAA)", M.Sc. Thesis (Shabiha Hosssin), Department of Environmental Science, Bangladesh University of Professionals, Mirpur Cantonment, Dhaka 1216, Bangladesh, 2021.
67. Joint-supervisor: Dr. Rahat Khan, "Reconciling the geogenic and non-crustal origins of elements in an Indo-Bangla transboundary river, Atrai: Pollution status, sediment quality, and preliminary risk assessment", M.Sc. Thesis (Amit Hasan), Department of Environmental Science, Bangladesh University of Professionals, Mirpur Cantonment, Dhaka 1216, Bangladesh, 2021.
68. Joint-supervisor: Dr. Shahzad Hossain, "Improvement in structural stability and electronic properties of Perovskite oxide $SrZr_{0.5}Y_{0.5-x}Ca_xO_3$ by doping Calcium for Solid oxide fuel cell application", M. S. Thesis (Fariha Tasnim), Department of Physics, University of Dhaka, 2022.
69. Joint-supervisor: Dr. Shahzad Hossain, "The influence of magnesium doping on $BaZr_{0.5}Y_{0.5-x}Mg_xO_3$ perovskite oxide for applications in solid oxide fuel cell", M. S. Thesis (Zerin Tasnim), Department of Physics, University of Dhaka, 2022.

Reactor Physics and Engineering Division, INST

70. Joint-Supervisor: Dr. Badrun Nahar Hamid, "FORM-SORM and monte carlo simulation approach for estimation of fuel failure probability of TRIGA core", M.Sc. Thesis (Nandita Talukder Munna), Department of Physics, Chittagong University, May 2022.
71. Joint-Supervisor: Dr. Badrun Nahar Hamid, "Directional simulation approach of reliability assessment methods for estimation of fuel failure probability of TRIGA reactor core, M.Sc. Thesis (Nosrat Sharmin), Department of Physics, Chittagong University, May 2022.

Isotope Hydrology Division, INST

72. Joint Supervisor: Dr. Md. Moniruzzaman, "Hydrogeochemical Evaluation and Potential Health Risk Assessment of Groundwater in Tangail, Bangladesh: An Approach to Isotopic and GIS Techniques", M.Sc Thesis (Hafiz Al-Asad), Department of Chemistry, Mawlana Bhashani Science and Technology Univeristy, 25 June, 2022.

Health Physics and Radioactive Waste Management Unit, INST

73. Co-supervisor: Dr. Md. Enamul Haque, Dr. K. Asaduzzaman, Dr. K. Munshi and Dr. Mahfuza Begum, "Evaluation of radioactivity and impact of gamma radiation on preservation and nutritional qualities of cultured fishes collected from different fish markets of Dhaka city", M.Sc. Thesis (Fahmida Jannati Priya), Department of Zoology, Jahangirnagar University, Jan. 2020.
74. Co-supervisor: Dr. Md. Enamul Haque, Dr. K. Asaduzzaman, Dr. K. Munshi and Dr. Mahfuza Begum, "Radiological impact assessment and effect of gamma irradiation on sensory, chemical and microbial changes of non-cultured fishes available in the fish markets of Dhaka city", M.Sc. Thesis (Doni Akter), Department of Zoology, Jahangirnagar University, submitted on Jan. 2020.

INSTITUTE OF FOOD AND RADIATION BIOLOGY (IFRB), AERE

Food Safety and Quality Analysis Division, IFRB

75. Supervisor: Dr. Md Shakhawat Hussain, "Isolation, identification, characterization and observation of the gamma irradiation effect on food born pathogen Klebsiella pneumoniae", M.Sc. Thesis (Ehsan Al Din Siam), Stamford University Bangladesh, Jul. 2021.
76. Supervisor: Dr. Md Shakhawat Hussain, "Prevalence of multi drug resistance and radio resistance Staphylococcus aureus in hospitals and their surrounding environment in Savar", M.Sc. Thesis (Nafisa Akhter) Dhaka, Jahagirnagar University, Dhaka, Jan. 2022.

Microbiology and Industrial Irradiation Division, IFRB

77. Joint-supervisor: Dr. Abdullah-Al-Mahin, "Optimization of direct production and recovery of second generation ethanol from water hyacinth", M.Sc. Thesis (Md. Main Uddin), Dept of Biotechnology and Genetic Engineering, Noakhali Science and Technology University. Noakhali-3814, Bangladesh, Apr. 2021.
78. Joint-supervisor: Dr. Abdullah-Al-Mahin, "Partial characterization of bacteriocin produced by lactic acid bacteria isolated from chicken intestine", M.Sc. Thesis (Md. Easin Mia), Dept of Biotechnology and Genetic Engineering, Noakhali Science and Technology University. Noakhali-3814, Bangladesh, Apr. 2021.
79. Co-supervisor: Dr. TabassumMumtaz, "occurrence of emerging contaminants in pharmaceutical WWTPs – a preliminary study", M.Sc. Thesis (NaziaAkhtarChowdhury), Department of Biochemistry and Molecular Biology, Jahangirnagar University, Savar, Bangladesh. Submitted on Apr., 2022.

Agrochemical and Environmental Research Unit, IFRB

80. Co-supervisor: Dr. Md. Alamgir Zaman Chowdhury, "Quantitative analysis of heavy metals and trace elements in the edible body parts of the chicken and risk assessment of human health", M.Sc. Thesis (Easmin Hossain), Department of Environmental Science, Jahangirnagar University, Jan., 2022.

Cytology and Biocontrol Research, IFRB

81. Joint-supervisor: Dr. Md. Hasanuzzaman, "Effects of insecticides on different organs of three indigenous fish species (Channa punctatus, Heteropneustes fossilis and Anabas testudineus) in the wetlands of Dhamrai area, Bangladesh", Ph. D. Thesis (Mohammad Sohidul Islam), Department of Zoology, Faculty of Biological Sciences, Jahangirnagar University, Savar, Dhaka, Bangladesh, Ph. D. degree awarded on Oct., 2021.
82. Co-supervisors: Dr. Farzana Yesmin and Dr. Md. Hasanuzzaman, "Assessment of some physico-chemical parameters of water, macrobenthos community and cytogenetic analysis of Chironomids (Chironomus spp.) of the Bangshi River, Savar, Dhaka", M. Sc. Thesis (Sumona Barman), Department of Zoology, Faculty of Biological Sciences, Jahangirnagar University, Savar, Dhaka, Bangladesh, M. Sc. 23 May, 2022.

Veterinary Drug Residue Analysis Division, IFRB

83. Co-supervisors: Md. Hedayetul Islam and Dr. Nurul Karim, "Validation of a High-Performance Liquid Chromatography equipped with Kobra Cell method for the simultaneous detection of aflatoxins B1, B2, G1 and G2 in rice sample available in Bangladesh", M. s. Thesis (Registration No.: 38557, Examination Roll No.: 181241), Department of Biochemistry and Molecular Biology, Jahangirnagar University, Savar, Dhaka, July 2021.
84. Co-supervisors: Dr. Md. Nazrul Islam and Dr. Nurul Karim, Development of a simplified High-Performance liquid Chromatographic method for the detection of aflatoxins B1, B2, G1and G2 in wheat samples available in Bangladesh", M. s. Thesis (Registration No.: 38576, Examination Roll No.: 181246), Department of Biochemistry and Molecular Biology, Jahangirnagar University, Savar, Dhaka, July 2021.

INSTITUTE OF TISSUE BANKING AND BIOMATERIALS RESEARCH (ITBBR), AERE

85. Joint-Supervisor: Dr. S. M. Asaduzzaman, "Fabrication and Physicochemical Characterization of Silver Nanoparticle Incorporated Hydroxyapatite-Chitosan-PVP Based Scaffold as a Drug Delivery System for Bone Tissue Engineering", M.Sc. Thesis (Monira Islam Chamely), Department of Biochemistry and Molecular Biology, MawlanaBhashani Science and Technology University, Santosh, Tangail, February 2022.

INSTITUTE OF ELECTRONICS (IE), AERE

Solar Cell Fabrication and Research Division, IE

86. Joint-supervisor: S. M. Amir-Al-Zumahi, "Impacts of dopants and annealing temperatures on structural, morphological and electrical properties of ZnO nanoparticles/ nanorods thin films", MS Thesis (Awsaf Abdun Noor), Department of Physics, Jahangirnagar University, Savar, Dhaka, Dec. 2021.
87. Joint-Supervisor: S. M. Amir-Al-Zumahi, "Study of Titanium (Ti) doping on structural, microstructural and morphological characteristics of ZnO", MS Thesis (Md Burhan Uddin), Department of Physics, Jahangirnagar University, Savar, Dhaka, Jan. 2022.
88. Joint-Supervisor: S. M. Amir-Al-Zumahi, "Study of silver (Ag) doping on structural and optical characteristics of ZnO nanoparticles", MS Thesis (Symul Haque), Department of Physics, Jahangirnagar University, Savar, Dhaka, Jan. 2022.
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INSTITUTE OF NUCLEAR MEDICAL PHYSICS, AERE

90. Co-supervisor: Sarmin Sultana, "Comparison of beam profiles for physical and enhanced dynamic wedges", M.Sc. Thesis (Bahalul Hasan), Master of Science, Department of Medical Physics and Biomedical Engineering (MPBME), Gono University, Savar, Dhaka, Bangladesh, Apr. 2022.
91. Co-supervisor: Md. Abul Hasnat, "Study on medical linear accelerator and quality control results by analysing PDD at institute of nuclear medical physics, BAEC", M.Sc. Thesis (Md. Akhtar-Uz-Zaman Shabuj), Department of Physics at Uttara University, Dhaka, Bangladesh, Dec. 2021.
92. Co-supervisor: Md. Abul Hasnat, "Transmission Factor of Medical LINAC installed at Nuclear medical physics institute, BAEC", M.Sc. Thesis (Sayed Bony Amin), department of Physics at Uttara University Dhaka, Dec. 2021.
93. Co-supervisor: Mannu Bardhan Paul, "Determination of PET-CT scan facility radioactive zone shielding design & safety matters", M.Sc. Thesis (Sheikh Sharier Islam), Department of Physics, JU, Dec. 2021.
94. Co-supervisor: Mannu Bardhan Paul, "Determination of radiation exposure to INMP patients and radiation workers", M.Sc. Thesis (Prasanto Ray), Department of Physics, JU, Dec. 2021.
95. Co-supervisor: Mannu Bardhan Paul, "Determination of radioactive zone selection and its improvisation", M.Sc. Thesis (Tanoy Saha), Department of Physics, JU, Dec. 2021.

INSTITUTE OF ENERGY SCIENCE, AERE

96. Co-supervisor: Dr Mohammed Tareque Chowdhury, "Synthesis and compositional analysis of ZnO powder using different chemical precursor", M.Sc. Thesis (Ummay Sumaya), Department of Physics, University of Dhaka, Mar. 2022.

NATIONAL INSTITUTE OF NUCLEAR MEDICINE AND ALLIED SCIENCES (NINMAS)

97. Supervisor: Dr. S. Momtaz Ferdousi Begum, "Evaluation of metabolic and morphologic changes of breast cancer after neo-adjuvant chemotherapy by 18F FBG PET-CT scan", MD Thesis (Dr. M. Mezbah Ahmed), Department of National Institute of Nuclear Medicine & Allied Sciences under BSMMU, January 2022.
98. Supervisor: Dr. Sadia Sultana, "Non-invasive assessment of myocardial perfusion abnormally type 2 diabetic patients without symptoms of coronary artery disease by SPECT-MPI", MD Thesis (Dr. Mohammad Nurul Azam), Department of National Institute of Nuclear Medicine & Allied Sciences under BSMMU, January 2022.
99. Supervisor: Dr: Fatima Begum, "Short term outcome of radioactive iodine ablation therapy in patients of papillary thyroid carcinoma with B-RAF mutation", MD Thesis (Dr. Papia Akhter), Department of National Institute of Nuclear Medicine & Allied Sciences under BSMMU, January 2022.
100. Supervisor: Dr. Sadia Sultana, "Association of excess dietary iodine intake with papillary thyroid carcinoma", MD Thesis (Dr. Sutanu Roy), Department of National Institute of Nuclear Medicine & Allied Sciences under BSMMU, January 2022.
101. Supervisor: Dr. Zeenat Jabin, "Association of higher level of thyroid antibodies (TRAB and TPOAb) with occurrence of hypothyroidism after radio-iodine therapy in patients with graves' disease", MD Thesis (Dr. Amardeep Chaudhary), Department of National Institute of Nuclear Medicine & Allied Sciences under BSMMU, January 2022.
102. Supervisor: Dr. Faria Nasreen, "Association of High TPO ab titer with differentiated thyroid carcinoma: a case-control study", MD Thesis (Dr. Umme Salma), Department of National Institute of Nuclear Medicine & Allied Sciences under BSMMU, April 2022.
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104. Supervisor: Dr. Faria Nasreen, "Correlation of b-mode and doppler ultrasound parameters of kidney with serum creatinine level inee chronic kidney disease patients". MD Thesis (Dr. Prianka Jabin), Department of National Institute of Nuclear Medicine & Allied Sciences under BSMMU, April 2022.
105. Co-supervisor: Md. Nahid Hossain, "Performance measurement of gamma camera, a theoretical studay", MS Report (Md. Faruk Hossain), Department of Physics, Jahangirnagar University, June 2022.
106. Co-supervisor: Md. Nahid Hossain, "Radiation monitoring of PET-CT lab at NINMAS (National Institute of Nuclear Medicine and Allied Sciences, BSMMU, Bangladesh)", MS Report (Delowar Hossain), Department of Physics, Jahangirnagar University, June 2022.
107. Co-supervisor: Md. Nahid Hossain, "Radiation monitoring of scintigraphy lab of NINMAS, a experimental study", MS Report (Jihan Uddin), Department of Physics, Jahangirnagar University, June 2022.
108. Co-supervisor: Md. Nahid Hossain, "performance of evaluation of SPECT-CT system at NINMAS", A Theoreitical Study, MS Report (Md. Tachadduk Saber), Department of Physics, Jahangirnagar University, June 2022.
109. Co-supervisor: Md. Nahid Hossain, "Acceptance testing of dose calibration at NINMAS", MS Report (Mir Mahbubul Hasan Rakib), Department of Physics, Jahangirnagar University, June 2022.

INSTITUTE OF NUCLEAR MEDICINE AND ALLIED SCIENCES (INMAS), DHAKA

110. Co-supervisor : Md. Selim Reza, "Acceptance Testing and Quality Control of Positron Emission Tomography (PET)", B.Sc Thesis (Md. Humayun Kabir Himal) Department of Medical Physics & Biomedical Engineering, GonoBishwabidyalay, Savar, Dhaka, Bangladesh, 2022.
111. Co-supervisor: Md. Selim Reza, "Radiation dose assessment around patients in SPECT/CT (Single Positron emission Computed Tomography) units Bone scan", B.Sc Thesis (Bahalul Hasan), Department of Medical Physics & Biomedical Engineering, GonoBishwabidyalay, Savar, Dhaka, Bangladesh, 2022.
112. Co-supervisor: Prof. Jasmine Ara Haque, "Association of subclinical thyroid Disorder in Hypertensive pregnant woman attending at tertiary care hospital", M.S. Resident (Phase B) Thesis (Dr. Fahmida Sultana Mili), Department of Obstetrics and Gynaecology, DMCH, Dhaka, 2022.
113. Co-supervisor: Prof. Jasmine Ara Haque, "Correlation of Renal sonographic finding with histopathology", M.D. Nephrology (Phase B) Thesis (Dr. Md. Tamim Aziz), Department of Nephrology, DMCH, Dhaka, 2022.
114. Co-supervisor: Prof. Jasmine Ara Haque, "Study of Bone Mineral Density in patients with informatory Bowel Disease", M.D. Gastroenterology (Phase B) Thesis (Dr. Atiqur Rahman), Department of Gastroenterology, DMCH, Dhaka, 2022.
115. Co-supervisor: Dr. Afroza Akhter, "Correction of ^{99m} Tc- HMPAO SPECT Imaging Findings and Vitamin D level with clinical staging of Parkinson's Disease", M. D. Neurology Thesis (Dr. Abul Hasnat Md. Rasel), Department of Neurology, SSMCH, Dhaka, 2022.

NUCLEAR SAFETY, SECURITY AND SAFEGUARDS DIVISION (NSSSD), HQ

116. Co-supervisor: Dr. Md. Shakilur Rahman, "Dosimetry of High Energy Photon and Electron Beams with Thimble and Parallel Plate Ionization Chamber", MS Thesis (Muhammad Shahidullah), University of Chittagong, Apr. 2022.
117. Co-supervisor: Dr. Md. Shakilur Rahman, "Measurement of Radiation Dose for small Radiation Field with Various Radiation Detectors for ^{60}Co Beam", MS Thesis (TanginaAkter), University of Chittagong, Apr. 2022.
118. Co-supervisor: Dr. Md. Shakilur Rahman, "Measurement of Outfield Dose and Associated Risk for High Energy Photon Beam (^{60}Co)", MS Thesis (Md. Zahid Hossain), University of Chittagong, Apr. 2022.
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NUCLEAR POWER AND ENERGY DIVISION (NPED), BAEC

120. Supervisor: Dr. Muhammed Mufazzal Hossen, "Sensitivity analysis for loss of coolant accident at the cold leg of VVER-1200 for different break sizes using PCTRAN", B. Sc. Thesis (A.B.M. Jobair Hossain Apurba), Department of Nuclear Engineering, University of Dhaka, 2022.

ATOMIC ENERGY CENTRE, CHATTOGRAM (AECC)

121. Co-supervisor: Dr. Shahadat Hossain, "Radioactivity measurements and analyses of soil and sediment samples taken from Chittagong city and port area on the northern shore of the Karnaphuli River", M. Sc Thesis (Israt Alam Shaulin), Department of Physics, Chittagong University, Jun. 2022.
122. Co-supervisor: Dr. AKM Saiful Islam Bhuian, "Ionizing radiation protection efficiency of common mortar and concrete used for infrastructure construction in Bangladesh", M. Sc Thesis (Nusrath Jahan), Department of Mechanical Engineering, Chittagong University of Science & Technology, Feb. 2022.
123. Co-supervisor: Dr. AKM Saiful Islam Bhuian, "Spatial distribution of radiological parameters from NORMs measurement of Bangladesh using GISMapping technique", M. Sc Thesis (Md. Ashik Azad Khan Anik), Department of Physics, Chittagong University, Jun. 2022.

124. Co-supervisor: Nipa Deb, "Estimation of Potential Toxic Heavy Metal in Rice of Chittagong District", M. Sc Thesis (MD. Rubel Hossain), Department of Physics, Chittagong University, Jun. 2022.

125. Co-supervisor: Chowdhury Kaiser Mahmud, "Biosorption of toxic heavy metal lead ion by raw tea leave in the Chittagong zone", M. Sc Thesis (Debosmita Chowdhury), Department of Physics, Chittagong University, Jun. 2022.

XV. INTERNATIONAL/NATIONAL PUBLICATIONS

ATOMIC ENERGY CENTRE (AEC), DHAKA

Chemistry Division, AECD

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2. S. Shorna, S. B. Quraishi, M. M. Hosen, M. K. Hossain, B. Saha, A. Hossain and H. Al-Mamun, "Ecological risk assessment of trace metals in sediment from the Old Brahmaputra river in Bangladesh", Chemistry and Ecology, Vol. 37, 9-10, pp 809-826, (2021), doi: 10.1080/02757540.2021.1989422.
3. A. A. Ullah, S. Afrin, M. M. Hosen, M. Musarrat, T. Ferdoushy, Q. Nahar and S. B. Quraishi, "Concentration, source identification and potential human health risk assessment of heavy metals in chicken meat and egg Bangladesh", Environmental Science and Pollution Research, Vol. 29, 22031-22042, 2021, doi: 10.1007/s11356-021-17342-4.
4. A. H. Reaz, S. Saha, C. K. Roy, M. M. Hosen, T. S. Shuvo M. M. Islam and S. H. Firoz, "Performance improvement of supercapacitor materials with crushed 3D structured graphene", Journal of The Electrochemical Society, Vol. 169.1, 010521, (2021), doi: 10.1149/1945-7111/ac4930.
5. S. Sultana, M. B. Hossain, T. R. Choudhury, J. Y., M. S. Rana, M. A. Noman, M. M. Hosen, B. A. Paray and T. Arai, "Ecological and human health risk assessment of heavy metals in cultured shrimp and aquaculture sludge" Toxics, Vol. 10.175, 1-17, (2022), doi: 10.3390/toxics10040175.
6. D. Roy, F. Rahman, S. S. Islam, S. Sarker, S. B. Quraishi and M. M. Hosen, "Bioaccumulation of heavy metal in urban pond reared Oreochromisniloticus, water, sediment and handmade feed in Bangladesh and human health risk implications", Arabian Journal of Geoscience, Vol. 15.959 (2022), doi: 10.1007/s12517-022-10260-w.
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9. M. S. Hossain, M. K. Ahmed, E. Liyana, M. S. Hossain, Y. N. Jolly, M. J. Kabir, S. Akter and M. S. Rahman "A case study on metal contamination in water and sediment near a coal thermal power plant on the eastern coast of Bangladesh", Environment, 8(10), 108,(2021), https://doi.org/10.3390/ environments8100108.
10. M. R. J. Rakib, Y. N. Jolly, D. C. Dioses-Salinas, C. I. Pizarro-Ortega, G. E. De-la-Torre, M. U. Khandaker, A. Alsubaie, A. Raheem S. A. Almalki and D. A. Bradley, "Macroalgae in biomonitoring of metal pollution in the Bay of Bengal coastal waters of Cox's Bazar and surrounding areas", Scientific Reports, 11(1), 1.13, (2021).

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XVI. PAPER PRESENTED IN SEMINAR/SYMPOSIUM/CONFERENCE/WORKSHOP

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