ANNUAL REPORT

July 2018 – June 2019

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 & development (R&D) programs in physical sciences, biological sciences, engineering sciences and nuclear power field have been undertaken in the light of the overall need of the country, so that the outcome of the activities can be directly contributed for socio-economic betterment in food & agriculture, industry, power, health or medicine and environmental protection.

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

The R&D programs of BAEC are executed through its different institutes, centres. The laboratories of all the institute/centres are equipped with state-of the-art facilities. The major facilities include 3 MW BTRR, 3MV Tandem Accelerator Facility, 3MV Van de Graff Accelerator, Two Co-60 gamma irradiator, Central Radioactive Waste Processing and Storage Facilities, Nuclear apparatus and scanning devices in National Institute of Nuclear Medicine & Allied Sciences (NINMAS) and 14 Institute of Nuclear Medicine & Allied Sciences (INMAS) located at different district headquarters, Radioisotope Production Laboratory, Radioactivity Testing and Monitoring Laboratory, air particle monitoring facility, Beach Sand Minerals Processing Pilot Plant etc.

Apart from R&D activities, the following divisions of BAEC are playing vital role in executing various programs.

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

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

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

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

R&D activities conducted during the period of July 2018 to June 2019 in the various fields of nuclear science & technology are described in this report.

RESEARCH & DEVELOPMENT AND SERVICE ACTIVITIES

I. PHYSICAL SCIENCES

ATOMIC ENERGY CENTRE (AEC), DHAKA

Chemistry Division, AECD

Objective

The objective of this Division is to make significant contribution towards socio-economic development of Bangladesh through different R&D programs of the Bangladesh Atomic Energy Commission and analytical services to potential end users of the country.

Programme

The Chemistry Division of the Atomic Energy Centre, Dhaka has been recognized both nationally and internationally as one of the leading Research Hubs in the field of Analytical Chemistry. To fulfil the demand of the present millennium, quality assured chemical analysis in samples of different description is ever increasing. The laboratory has been able to make significant contribution towards socio-economic development of the country through different R&D activities and analytical services to potential end users. This Division is pursuing R&D activities in some selected branches of Chemistry focusing the socio-economic development of the country. In collaboration with the Universities, Research Organizations and Medical Institutes, the Division carries out some specific research programmes and also provides academic training to the University students. Technical services in the form of Chemical Analysis of Materials, Routine Analytical services for Diagnostic purpose and Consultant/Expert Services in any special cases are provided with care and utmost precision to the different Organizations. The Division also participates in Coordinated Research Programmes under IAEA/RCA framework and Research Projects under MOST special grant programme, particularly in the field of Environmental Pollution, Nuclear Analytical Techniques in Material Analysis and Environmental Studies. The specialized branches of Chemistry that cover these efforts are illustrated below.

Activities

1. Research and Development Work(s)

Advanced Analytical Chemistry

1.1 Participation in proficiency testing for the analysis of trace elements in sediment, water, dairy products, seafood and feed samples organized by IAEA, FAPAS and BIPEA

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

The Analytical Chemistry Laboratory (ACL) of Chemistry Division is an ISO/IEC 17025:2005 accredited laboratory. According to the standards, in order to maintain the laboratory accreditation, it is mandatory to participate in the proficiency testing (PT) at least once in a year organized by any internationally recognized standard/reference laboratory and secure satisfactory results that ensure the quality of analyses, validity of the methods used and performances of analysts as well as instruments. ACL has participated in proficiency testing (PT) namely "IAEA-MESL-ILC-TE Sediment-2018" for the quantification of As, Cd, Co, Cr, Cu, Fe, Hg, Mn, Ni, Pb and Zn in sediment sample; 'FAPAS PT' for the quantification of Ca, Mg, Na and K in water; and 'BIPEA PT' for the analysis of Pb, Cd, Cr, As, Hg, Mn, Ni andCo in dairy products, seafood and feed samples. The laboratory has secured satisfactory results for the quantification trace elements quantified by Atomic Absorption Spectrophotometry (AAS) and Inductively Coupled Plasma-Mass Spectrometry (ICP-MS) techniques. The results indicate the capability of the laboratory to provide quality data for the quantification of trace elements in different environmental and food samples.

1.2 Development of a GF-AAS method for the quantification of arsenic in fish samples

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

Fish is the most important single source of high-quality protein that consumed by all classes of people. Due to natural and anthropogenic activities, the environment is being polluted where fish is the most vulnerable

among the aquatic biota. Among the various contaminants, arsenic is an element of concern given its toxicological significance, even at low concentrations.A graphite furnace-atomic absorption spectro-photometry (GF-AAS) method was developed for the trace level determination of arsenic (As) in fish samples. For this purpose, a good number of instrumental and method parameters were optimized following the international guidelines. The linearity was obtained as 10 to 75 µg/kg for the quantification of As in fish samples. The furnace temperature was optimized which was found as 2800 °C. Generally, in case of GF-AAS matrix modifier is used separately during the analysis, however, in the present case better recovery was found when the matrix modifier was added with the sample preparation step. In the present study, it was obtained that, 10% $Pd(NO_3)_2$ and 3 M HCl modifiers showed 99% recovery indicating the method's suitability for the purpose.

1.3 Morning (first) urine copper concentration: a new approach for the diagnosis of Wilson's disease

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

Twenty-four-hour (h) urinary copper content is considered as the most suitable tool for the diagnosis of Wilson's disease (WD); however, it is less accurate, time-consuming, and non-economical. Therefore, an alternative method throughmeasuring the morning (first) urine copper (Cu) concentration is proposed for the diagnosis of WD, which is more accurate, precise, faster, and cheaper. For this purpose, a sensitive, accurate, and precise analytical method was developed and validated in regard toCommission Decision 657/2002/EC, Council Directive 333/2007/EC, ISO/IEC 17025:2005, and EURACHEM 1998 for thedetermination of Cu in urine using flame atomic absorption spectrometry (FAAS). The methods LoD and LoQ for urine Cu wereestimated as 6.68 µg/L and 16.7 µg/L respectively. The accuracy of the method was found to be 93.70–101.88% calculated from thespike recovery experiment. The RSDs for the repeatability and reproducibility precision were measured as 0.67–3.16 and 0.26–1.95respectively. The method validation performance criteria indicated that the method was suitable for the determination of Cu in urine.The validated method was then applied for the determination of Cu in both 24 h and first urine. From the analysis, it was found thatthe amount of Cu per liter in the first urine was almost equivalent to the amount of Cu per 24 h indicating that instead of consideringthe 24-h urine, morning (first) urine investigation might be an alternative approach for the diagnosis of WD.

1.4 Validation of analytical method for the determination of lead (Pb) in milk using inductively coupled plasma-mass spectrometry (ICP-MS) technique

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

A sensitive, accurate and precise method was developed and validated in regard to international guide line for the trace level determination of Lead (Pb) in milk sample using Inductively Coupled Plasma-Mass Spectrometry (ICP-MS) technique. For method validation linearity, limit of detection, limit of quantification, trueness (recovery) and precision (repeatability and reproducibility) have been assessed as performance criteria. The linearity was found to be 1-50µg/L. The instrumental limit of detection (LoD) and limit of quantification (LoQ) were found to be 0.5 µg/L and 1µg/L respectively, whereas, the method LoD and LoQ was found to be 0.5µg/kg and 1µg/kg respectively. Moreover, the recovery of the analyte was measured to be 83-99 % and the RSD values for precision were 5-11%. The method validation performance criteria indicate the method's suitability for trace level quantification of Pb in milk samples. The expanded uncertainties were also calculated and found to be 25 %.

Food Chemistry

1.5 Dietary intake of essential and toxic metals through the consumption of rice and possible human health risk assessment in Bangladesh

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

Rice (*Oryza sativa*) is a global staple food crop that provides the primary source of calories for more than 50% of the world's population. More than 3.5 billion people depend on rice for more than 20% of their daily calories. Rice provided 19% of global human per capita energy and 13% of per capita protein in 2009. In that, more than 90% of rice is consumed in Asia, where it is a staple food for a majority of the population. In Bangladesh, rice accounts for more than 58% of the protein intake. Hence, concentrations of six essential elements (Mg, Na, Ca, Zn, Cu and Fe) and four heavy metals (Pb, Cd, Cr and As) in rice samples namely Kataribhog, Najirshail, Miniket, Bashful, Banglamoti and Brand rice (Prince, Pran and ACI Miniket)

collected from four local markets and three mega shops of Dhaka City, Bangladesh were measured using atomic absorption spectrometry (AAS) in order to evaluate their contribution to nutrition and potential health risks form the consumption of rice. The concentrations of Mg, Na, Mg, Zn, Cu and Fe were found to be in the ranges from 96.41-149.56 mg/kg, 12.74-83.18 mg/kg, 59.84-150.37 mg/kg, 7.85-15.70 mg/kg, 2.64-3.83mg/kg,5.35-12.33 mg/kg respectively; and the concentrations of toxic elements Cd,Pb,Cr and As were found to be 0.032-0.159mg/kg,0.073-0.678mg/kg,0.626-3.045mg/kgand <0.08-0.193mg/kgrespectively. In general, the concentration pattern of essential elements and toxic metals in rice was decreased as: Mg> Ca> Na> Zn> Fe> Cu and Cr> Pb> Cd> As respectively. The estimated daily intake (EDI) of all the studied heavy metals calculated on the basis of mean rice consumption of 416 g/person/day by Bangladeshi households indicates that no risk to people's health with respect to the EDI of studied heavy metals through the consumption of the selected rice samples. From the human health point of non-carcinogenic risk indicates Cd, Pb and As through the consumption of rice is safe for human health. Also, the estimation showed that the carcinogenic risk of Cr (5.8×10^{-4}) exceeded the USEPA accepted risk level of 1×10^{-6}. Thus, the carcinogenic risk of Cr through rice consumption for Bangladeshi people is a matter of concern.

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1.6 Study of essential and toxic elements in fruits and evaluation of food value for Bangladeshi people

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

The concentrations of seven essential elements (Ca, Mg, Na , K, Cu, Zn, and Fe) and four heavy metals (Pb, Cd, Cr, and Hg) in ten indigenous fruit species, Apple (*Malus pumila),* Banana (*Musa sapientum),*Mango (*Mangifera indica),*Pear (*Pyrus communis),* Pomegranate (*Punciagranatum),* Guava (*Psidium guajava),* Orange (*Citrus chryosocarpa),* Grape (*Vitis vinfera),* Papaya (*Carica papaya),*and Malta (*Citrus sinesis)* collected from different local markets of Dhaka city, Bangladesh were measured using atomic absorption spectrometer (AAS) in order to evaluate their contribution to nutrition and potential health risks from the consumption of fruits. The concentrations of essential elements in the fruit samples were found to be 32.01-418.7 mg/kg for Ca, 18.6-320.18 mg/kg for Mg, 3.46-75.8 mg/kg for Na, 1394. 34-7103. 27 mg/kg for K, 0.44-40.9 mg/kg for Cu, 0.70-8.08 mg/kg for Zn and 0.4-5.7 mg/kg for Fe. The concentrations of toxic elements in fruit samples were found to be 0.062-0.34 mg/kg for Pb, 0.053-0.34 mg/kg for Cr. The Hg and Cd concentrations inthe investigated fruit samples were found below the detection limit (<0.02 mg/kg for Hg and <0.01 mg/kg for Cd) except in Pear (*Pyrus communis)* fruit. The contributions of the studies fruit species to nutrients are >1% for Ca, >5% for Mg, >0.1% for Na, >2.82% for Zn, >5.94% for Fe and 8.4% for K indicating that the indigenous fruit species contribute maximum amount of K nutrient. The estimated daily intake (EDI) of all the studied heavy metals calculated on the basis of mean fruit consumption of 44.7 g/person/day by Bangladeshi households indicates that no risk to people's health with respect to the EDI of studied heavy metals through the consumption of the selected fruit samples. From the human health point of view,the estimation of non-carcinogenic risk indicates that intake of individual heavy metals as well as combined heavy metals through the consumption of fruit is safe for human health.

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1.7 Evaluation of organ-specific trace metal concentrations and human health risk considering different ages of *Labeo calbasu* and *Ompok pabda* collected from aquaculture fish farm of Mymensingh area, Bangladesh

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

Now-a-days, the tendency of organ specific trace metal accumulations in different age groupof fresh water organism, especially in fishes has noticed, which may cause severe health hazard by entering into human metabolism through consumption. Five heavy metals such as Nickel (Ni), Chromium (Cr), Mercury (Hg), Lead (Pb) and Cadmium (Cd) were determined in in two highly consumed fish species *Labeo calbasu* and *Ompok pabda* using atomic absorption spectrophotometer (AAS). Metal concentrationswere assessed in three phases from the age of 3 months to 9 months (closed to marketablesize) of sample fishes in their different organ systems (whole fish are considered for 3 and 6months; body muscle, gut and gill were taken from 9 months age group). In general, higherNi concentration was detected in gill tissues than the muscle tissue of selected fishes whichexceeded the standard value (1mg/kg ww WHO, 1998). Cr concentration was higher in

3months age group of Kalbasu (2.42 mg/kg ww) and gills in 9 months age of Pabda (0.72mg/kg ww) where Kalbasu exceeded the standard value (1 mg/kg ww).Concentration of Hgfound bellow its safety range for both Kalbasu (0.021 mg/kg ww) and Pabda (0.15mg/kg ww). Pb found above the safety range at whole body of 3 months age for Kalbasu but found bellow the safety range for Pabda. Similar observation was noted for Cd accumulation in the gut of both fishes at the age of 9 months. Metal concentrations in handmade feed samples which applied for three months age group are given in descending order Cr>Ni>Cd>Pb>Hg; company feed 'CP' for Kalbasu and 'Paragon' for Pabda are Ni>Hg>Pb>Cd>Cr and Ni>Pb>Cd>Cr>Hg respectively. The water and sediment quality of the pond of Kalbasu and Pabda was also observed. Ni was found higher in water and sediment for both fish ponds. All these observations suggest that the feeding habit of fish and the habitat they are living in has influence on metal accumulation. But the contamination factor (CF) less than 1, ecological risk factor (Er) less than 40, pollution load index (PLI) less than 1 and geo accumulation index (Igeo) less than 0 meaning that the pollution factor is low, potential ecological risk is low, sampling sites are unpolluted of trace metals and fall within unpolluted category.

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1.8. A comparative study of heavy metal exposure risk from the consumption of some common variety of cultured and captured fishes of Bangladesh

Y. N. Jolly, M. R. Habib*, M. M. Hoque*, J. Kabir, S. Akhter and N. Sultana

A comparison of heavy metals such as Fe, Cu, Zn, As, Hg, Pb between commonly consumed cultured and captured fishes of Bangladesh has been estimated in this study. The assessment revealed that among all other identified metals, Zn has been found the highest concentration present among the fishes followed by Fe, Cu and others. Samples have been prepared in both Flesh and Bones to differentiate the risk of flesh and bone consumption. The HRI of Pb in almost all the samples has exceeded the permissible limit (<1) set by US-EPA and FAO. The HI of the concerned heavy metals of the flesh of *Labeo ruhita* (cultured) has been found as 159.721 ppm (µg/g dry weight) whereas the HI in Bone has been detected as 163.153 ppm (µg/g dry weight). The Toxicity scores and Daily Ingestion amount has shown substantial rate of possibility to be exposed to heavy metals through fish consumption, specially cultured fishes.

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1.9 Trace metals in fish samples collected from Halda river and their health risk assessment

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

A total of six species of fish namely: of Rohi, Katla, Spotfin swamp barb, Mola carplet, Goby and Climbing perch investigated for heavy metals. All varieties of samples showed the level of As, Cr, Mn, Co, Ni below their detection limit of analytical system (As: 0.41, Cr: 0.41, Mn: 0.31, Co: 0.28, Ni: 0.24) in mg/kg respectively. The concentrations of the elements- Ca, Fe, Cu, Zn, Hg, and Pb in all varieties of fishes varied from 138.18-336.28, 52.07-870.84, 17.181-26.412, 48.25-115.54, 0.39-2.11, 0.23-0.51 mg/kg respectively. Among different fish samples Metal Pollution Index (MPI) followed a decreasing sequence of Mola carplet (19.87)> Katla (18.93)> Goby (18.04) > Climbing perch (16.71)> Spotfin swamp barb (15.63)> Rohu (13.27). The result showed that the health risk index (HRI) for Hg, Pb, Cu, Zn, Fe and Se in all types of fish samples are lower than 1 indicating safe for the consumer.

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

Y. N. Jolly, T. Rahman*, M. G. Mortuza*, M. S. Rahman, S. Akter, J. Kabir and K. M. Mamun

Five varieties of commonly consumed fish samples (locally named Katla, Ruhi, Ilish, Pangash, Telipia) have been collected from different fish markets of Dhaka city and analysed for heavy metal content (Fe, Se, Rb, Cr, Cu, Pb, Zn, As and Hg) using Energy Dispersive X-ray Fluorescence (EDXRF) Spectroscopy. Possible Health Risk due to dietary intake of this contaminated fishes also calculated. Among the five fish species, higher concentrations of Zn , Fe, Cu, Se, Rb,Pb and As were found in *P.Pangasius, L.Rohita* and *T.Ilisha.* Pb and As concentrations in fish muscle exceeded the international safe limits. Daily intake of metals showed that in case of regular consumption there was no harmful effect on general public health from the consumption of the studied fish. Long-term intake of contaminated fish samples could lead to toxicity of heavy metals in human beings.

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

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

A total of 10 Fish samples were collected from the Buriganga river and analysed for heavy metal (Ca, Cr, Mn, Cu, Zn, As, Se, Fe, Se, Sr, Hg and Pb) concentration using EDXRF technique. All the concentrations were found lower than the safe value recommended by WHO Standard 2004, FAO/ WHO 1989, US FDA 1993 except Iron, Copper, Zinc and Mercury. The metal pollution index, for all sample of fishes are quite high. The health risk index (HRI) value, through the consumption of fish was less than 1 except Mercury in Kholshe and Copper in Tengra fish, indicating that there is no potential significant health risk associated with consumption of fishes other than Kholshe and Tengra. From the human health point of view, the THQ values for individual element were lower than 1, suggesting that there was no health risk for consumers due to intake of individual heavy metal, however, total THQ for combined heavy metals was higher than 1, indicating potential health risk to highly exposed consumers. The carcinogenic risk of mercury due to the consumption of fish was also of concern since the carcinogenic rate in fish was above the acceptable risk level of 10^{-2}.

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1.12 Assessment of heavy metal in surface sediments and selected fish species of Tanguar Haor, Sylhet

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

Surface sediment sample from Hathirgatha, Naindar and Lechuamara beel and four species of fish sample have been collected and analysed for heavy metal using EDXRF. Sediments are heavily polluted by Fe, unpolluted by Pb, moderately polluted by K. The Cf value inducate that most of the area was unpolluted by Cr, Cu, Zn, and Pb except As which shows a higher value than average shale value indicating anthropogenic source of contamination. On the other hand for fish sample no potential health risk was associated due to consumption.

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1.13 Potential human health risks of poultry chicken

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

The present study conducted to determine the concentration of toxic heavy metal in different parts of chicken, feed and water and to assess the possible carcinogenic and non-carcinogenic health risk due to consumption. A total of 10 chicken, 10 water and 5 feed samples were collected from different farms of Savar, Bangladesh and analysed for heavy metals (Ca, Mn, Cu, Co, Ni, Fe, Zn, As, Se, Gr, Rb, Sr, Hg and Pb) using EDXRF. This study showed that the Estimated Daily Intake of Ca and Fe arte higher than the maximum tolerable limit for people.

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1.14 A comparative study for the organic compounds in some brands of Green tea highly consumed by Bangladeshi people

A. R. M. Tareq, R. Sultana, A. K. M. A. Ullah and S. B. Quraishi

Green tea contains bioactive compounds that improve health. This study deals with the investigation of presence of the organic compounds in the collected green tea samples mostly consumed by Bangladeshi people Five Green tea samples namely KGT, FGT, TGT, FGT, LGT were analysed by the using of Gas Chromatography- Mass Spectroscopy technique. A total of 89 organic compounds were identified in five green tea. The sample was collected, dried in oven over 60°C, than it was crushed for homogenization. After crushing about 5.0g sample was taken into 50mL methanol and refluxed for 2.5 hours. The extracts were reduced to a volume of 1-2 mL evaporative concentration using nitrogen gas.VF-5 ms capillary column (30 m X 0.25 mm i.d., 0.25 µm film thicknesses) were use in GC. Helium was used as a carrier gas at a flow rate of 1.0 ml/min. Ionization mode was electron impact ionization and the scanning range was from 40 amu to 650 amu. The major organic compounds of KGT were Tritetracotane (Alkane) - 51.19%, (all-E)-2,6,10,15,19,23-hexamethyl-,2,6,10,14,18,22-Tetracosahexaene(Alkene) -10.13%, and 1-Ecosanol (Alchololic)- 5.02% etc. In

the FGT, the main compounds were 3, 4-bis [(trimethylsilyl) oxy]-estra-1, 3, 5(10)-trien-17-one (Ketone)-39.02%, eicosamethyl-Cyclodecasiloxane (Alkane)-19.63% and Tritetracotane (Alkane) - 5.02%. The major compounds of the TGT were 1-Ecosanol (Alchololic)- 15.28%, Tritetracotane (Alkane) - 7.74%, 5-methyl-2-(1-methylethyl)-, (1.alpha. 2.beta.,5.alpha.)-(.+/-.)-Cyclohexanol (Alchoholic)-7.62%. In the FGT, the main compounds were 3, 5, 24-trimethyl-Tetracontane (Alkane)-18.10%, 1-Ecosanol (Alchololic) - 10.85%, and oxime-(5.alpha.)-Androstan-17-one (Ketone)-11.25%. The major copoount of the LGT were (3.alpha.)-12-Oleanen-3-yl acetate (Alkene)- 60.59%, 1-Ecosanol (Alchololic)- 9.23%, and Tritetracotane (Alkane) - 5.13% etc.

1.15 Human health risk implication: an approach to some carcinogenic polycyclic aromatic hydrocarbons (PAH_3) in some selected tea bands

A. R. M. Tareq, R. Sultana, A. K. M. A. Ullah and S. B. Quraishi

The present study aimed to ascertain potential human health risk implication of tree carcinogenic polycyclic aromatics hydrocarbons in some selected tea bands. The study investigated the health risk assessment of tree carcinogenic polycyclic aromatic hydrocarbons (PAH_3) like benzo[a]pyrene, crycene, benzo[a]anthracene in collected tree black tea, four green tea, and fourteen herbal tea sampleswith Gas Chromatography-Mass Spectrometry (GC-MS) technique. Health risk implication of above mentioned compounds were calculated following the carcinogenic risk assessment model. The Carcinogenic Risk(CR) values of carcinogenic properties like Benzo(a)pyrene, Chrysene, Benzo(a)anthracene and as due to exposure from the consumption of tea samples were calculated as 9.57×10^{-5}, 9.57×10^{-6} and 6.38×10^{-8} respectively.The CR values of tea samples were ranged from 6.38×10^{-8} to 9.57×10^{-6} with the mean value 3.51×10^{-5} which is higher than previous investigation (Li et al.,2016). This is probably due to the fact that the higher PAHs concentrations in KLT-S5. This result could be explained by the fact that the adults have the highest ingestion rate of tea. Generally, the values of CR lower than 10^{-6} are considered as negligible, above 10^{-4} are considered to be unacceptable and lying in between 10^{-6} and 10^{-4} are considered as acceptable range (UAEPA, 1993, 2010,). In the present study, CR for Bezo(a)anyhracene was beyond the negligible range.

1.16 Ipomoea aquatic leaf extract: Identification of organic compounds using by GC-MS technique

A. R. M. Tareq, R. Sultana, A. K. M. A. Ullah and S. B. Quraishi

Ipomoea aquatica is one of the medicinally important plants belonging to the family convolvulaceae. The aim of the study is to identify the organic compounds in *Ipomoea aquatic* leaf using by GC-MS technique. The leaves were extracted with water (hydro-distillation process), then subjected to preliminary phytochemical screening and further GC-MS analysis. The preliminary screening showed the presence of while the GCMS result revealed 49 compounds. The major compounds were Phytol (10.41%), n-Hexadecanoic acid (9.27%), N, N-dinonyl -3-Trifluoromethylbenzylamine (5.03%), Spiro [2.4] hepta-4, 6-diene (4.07%), Phenylethyl Alcohol (3.63%), bis-4, 4'-(1-methylethylidene) Phenol (2.16%) and Benzyl alcohol (1.87%).

1.17 Investigation of carcinogenic Benzo(a)Pyrene (BaP) in some selected green tea, black tea and herbal tea ingested by Bangladeshi people

A. R. M. Tareq, J. Afsana*, R. Sultana, A. K. M. A. Ullah and S. B. Quraishi

To assess of toxicological risk measure among polycyclic aromatic hydrocarbons-benzo[a]pyrene (BaP) has been accepted as indicator owning to its high carcinogenic properties. Benzo[a]pyrene (BaP) was determined in collected tree black tea, four green tea, and fourteen herbal tea samples which are consumed by denizens of Dhaka city with Gas Chromatography-Mass Spectrometry (GC-MS) technique. The samples were extracted by dichlorometane: acetone (3:2). The extracted samples were pre-concentrated to 1-2 mL by using nitrogen gas. Prepared samples were subjected to GC-MS for the analyses of BaPThe most carcinogenic Benzo (a)pyrene (BaP) was found in highest range at Dr. H & H Amloki tea 30 µg/kg and on other samples the range is below detection level. The regulative value of Benzo(a)pyrene is 10 µg/kg set by EC. Detection limit is DL=0.57 µg/kg. The spike recovery of the BaP was found 74.90% demonstrated the perfect reliability and accuracy of the methodology employed in this disquisition.

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1.18 Toxic elements accumulation in vegetables from soil collected from the vicinity of a fertilizer factory and possible health risk assessment

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Present study deals with the investigation of the magnitude of toxic elements in commonly consumed vegetables grown in the vicinity of a Fertilizer Factory and evaluate the degree of health risk burden due to dietary intake of those vegetables as well. The vegetable samples showed greatest probabilities of toxic elements (Cr, Mn, Fe, Ni, Cu, Zn, As and Pb) contamination depending on their species and locations.In most cases concentration of all the elements (Cr, Mn, Fe, Ni, Cu, Zn, As and Pb) in soil samples are equal to or near the suggestive world average value. Health risk assessment showed that all the vegetables are highly contaminated with the toxic elements analysed. Estimated daily intake of metal revealed that all the elements are within the reference dose (suggested by WHO. USEPA) except arsenic (As) and lead (Pb) and therefore HRI value for As and Pb was also found significantly high to pose any health hazard. Calculated non-carcinogenic (THQ) value for Cr and Ni was below 1 but for As and Pb the THQ value was high enough for public health concern. Cr, Ni, As and Pb present in different vegetable samples posed significant levels of carcinogenic risk as their values exceed the safe limit (10-6 - 10-4) suggested by USEPA.

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Atmospheric and Environmental Chemistry

1.19 Heavy metal in dust and plant leaves in Dhaka, Bangladesh: possible health threat to urban population

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

Urban road dust pollution is becoming the major concerning issue due its re-suspension characteristics. Bangladesh is the mostly populated country and the annual vehicles emission poses threats to the environment and mostly on human health. Samples were collected from different location of Dhaka city and metals were detected by using Atomic Absorption Spectrophotometer (AAS). Levels of contamination of dust samples were evaluated by calculating contamination factor (CF), degree of contamination (DC) and pollution load index (PLI). The result summarized that the road dust samples of Dhaka city were “lower” to “moderately” polluted. The findings portrayed that the heavy metal concentration gradient increased in the order as: Pb > Hg > Cr > Cd > As both for dust and leaves samples. Pearson correlation coefficient and multivariate cluster analysis were also performed and four main sources with corresponding cluster elements were identified: 1. Pb-Cd, 2. Hg-Cd, 3. As-Hg and 4. As-Cr for road dust samples and 1. Pb-Hg, 2. Hg-Cr, 3. As-Cd and 4. As-Cr for plant leaves samples. Spatial distribution map was generated for both road dust and plant leaves samples. The highest concentrated zone of Pb and Hg were found in Amin bazar and lower concentrated zone of Pb and As were found in Bank Town sampling sites. Elemental health risk was assessed through dose calculations for carcinogenic and non-carcinogenic metals; and by the determination of LADD (lifetime average daily dose). The carcinogenic metals studied showed the following variation in their LADD values; Pb > Cr > Cd > As > Hg. The study revealed that both children and adults in all studied areas having health quotient (HQ) < 1 are at negligible non-carcinogenic risk. The most prominent exposure route was ingestion. The cancer risk for children and adults from exposure to Pb, As and Hg was found to be negligible (1×10^{-6}). The only exception was found for Cr and Cd expose both for child and adult which exceeds the permissible limit

1.20 Community structure of meiobenthos in the inter-tidal area of Sandwip and Kuakata sea beach

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

The analysis of benthic community structure is a good tool for describing changes inspace (with application in point source pollution monitoring) and time (with applicationin the description of changes in the state of marine systems). Every organism plays animportant role in the environment. For maintaining ecological balance of environmentexistence of micro, macro and meiobenthos is essential. Benthic fauna communities are important to aquatic ecosystem in that they serve as a food supply to the most of aquaticorganisms. The marine benthos is considered as the largest ecosystem on earth, andecosystem processes occurring within it have important effects both locally and globally.Hence, community structure of meiobenthos in the inter-tidal

area of Sandwip and Kuakata sea beach was conducted. For this purpose, Separate analyses were performed on the major taxa, copepod and nematode species.Univariate measures that were calculated were species richness, diversity and evenness, and total number of individuals. The significance of differences in univariate measureswas tested with ANOVA. Heavy metals such as lead, mercury, arsenic, copper, zinc andcadmium are toxic for the plants and humans even at a very low level of intake andaccumulate in living organisms and produce diseases and disorders. The heavy metalspollution has a great effect on diversity and distribution on meiobenthic organisms. Therepercussion of scarcity of information regarding the effect of pollution of heavy metalson meiobenthos in Bangladesh will be being prompted by the present study. As this willbe the first research about the community structure of meiobenthos and heavy metalaspollution in Sandwip and Kuakata Sea Beach region, it will be an important contributionto the future.

1.21 A comprehensive assessment of trace metals contamination in water, sediment and fish species of various habitat preferences and trophic guilds from the Brahmaputra river

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Six trace metals such as lead (Pb),nickel (Ni), chromium (Cr), mercury (Hg), cadmium (Cd), and arsenic (As) were analyzedin water, sediments and fish species of various habitat preferences and trophic guilds fromthe Brahmaputra River in Bangladesh. The decreasing trend of trace metal in water was found as Pb>Ni>Cr=As=Hg=Cd. The lead content exceeded the safe limits of drinkingwater which indicate that the water from this river is not safe for drinking and cookingpurposes. The decreasing trend of trace metal in the sediment sample was Ni>Cr>Pb>As> Hg>Cd and they were within the geochemical background value. Butmean concentrations of Ni and Cr were higher than those of the US Environmental Protection Agency's (US EPA) toxicity reference values (TRV). Nickel and chromiumhave also exceeded the lowest effect level (LEL) value but not the severe effect level (SEL). This indicates that Ni and Cr might have a moderate impact on aquatic biota. Ofthe six species of fishes, Pb and Ni were maximum in *B. barila;* Cr, Cd and As in *G.chapra*, and Hg in *S. acinsces*. All these species were omnivorous except *S. acinsces*, which was insectivorous and detrivorous. In case of habitat preference, it is observed thatbenthopelagic species accumulate more metal content than pelagic. All these observationssuggest that the feeding habit of fish and and the habitat they are living in has influence onmetal accumulation. But all the obtained value of trace metal in fish were lower than thestandard reference limit and the target hazard quotient (THQ) less than 1 suggest that thefishes are safe for human consumption and there is no health risks associated with it. Alsothe contamination factor (CF) less than 1, ecological risk factor (Er) less than 40, pollutionload index (PLI) less than 1 and geo-accumulation index (Igeo) less than 0 meaning thatthe pollution factor is low, potential ecological risk is low, sampling sites are unpollutedof trace metals and fall within unpolluted category.

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1.22 Assessment of Dhaleshwari river water quality due to industrial pollution

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Day by day the adverse effect of climate change is rising. This is being fostered by the irreparable damage done to various ecological systems and its components, commonly water bodies, by indiscriminate pollution from industrial waste and untreated effluents. The effect is most critical for developing countries like Bangladesh where economic interest often take over the concern for environmental safety and soundness, which calls for investigation of potential cases of pollution. The Dhaleshwari river being situated next to the newly setup Savar Tannery Estate is such a case. In our present work, we targeted the water quality of Dhaleshwari river through the analysis of physiochemical parameters viz. pH, Dissolved Oxygen (DO), Biochemical Oxygen Demand (BOD), Chemical Oxygen Demand (COD), Total Dissolved Solid (TDS), Turbidity, Salt Concentration and Conductivity of water and the chemical analysis of heavy metals e.g.cadmium (Cd), chromium (Cr) and mercury (Hg) of water, fish and sediment from the river. Samples were collected from various sites of the river on different time of the year and physical analysis were done using corresponding measuring meters where chemical analysis were done using Atomic Absorption Spectrometer(AAS). Results from both type of analysis often exceeded standard limit and thus suggest for further investigation in this regard on broader scale.

1.23 Assessment of heavy metals from water and sediment of Naval Academy, Kumira, Vatiary, and Fauzderhat areas of Chattogram

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Four water and four sediment samples were collected from Naval Academy, Kumira, Vatiary and Fauzderhat areas of Chattogram District and analyzed by Atomic Absorption Spectrophotometer for the heavy metals of Zn, Ni, Cd, Pb, As, Hg and Cu. The concentration of Zn was found to be in the range of 54.5 – 69.2 mg/L in water and 13.806 – 1561 mg/kg in sediment. Ni content was estimated as 21.6 – 43 mg/L in water and 1.195 – 8.020 mg/kg in sediment. In water Cd was measured as 17 – 84 mg/L and that in sediment was 0.25 – 1.7 mg/kg. The concentrations of Pb and Hg in water was found below the detection limit (<8 mg/L for Pb and <0.3 mg/L for Hg) whereas, those in sediment were found as 3.04 – 39.05 mg/L and <0.3 mg/kg. In water the concentrations of As and Cu were measured as <0.5 – 1.95 mg/L and 24.38 – 98.75 mg/L and those in sediments were calculated as 1.01 – 4.48 mg/L and 2.91 – 152.55 mg/kg respectively.

1.24 Metal concentration in salt marsh sediments and Macrophytes from Bangladesh coastal area

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

Sediment samples and macrophytes were collected from six salt marsh habitats from Bangladesh coastal area in January 2018 and analysed using EDXRF. Metal content in soil samples for Pb, Zr, Sr, Rb, As, Zn, Cu, Ni, Fe, Cr, Ti, Ca, K ranged from 1.35-10.42, 96.21-161.35 , 138.32-209.64, 124-186.57, <4.17, 37.71-44.95, 36.51-51.66,<0.19, 25020-35177, <5.18, 2678-3341, 8679-16323, 23680-16770 mg/kg respectively. Contamination factors in the sediment followed the order of $S_9>S_6>S_{11}>S_7>S_2>S_{13}>S_{15}>S_{18}>S_5>S_4>S_{11}>S_8>S_{16}>S_3>S_1>S_{14}>S_{17}$. Geo-accumulation Index in the sediment of the eastern coast site can be treated as unpolluted to moderately polluted with Cu, Zn, Rb, Sr, Zr, and Pb but practically unpolluted with Cr, Ni, As, Fe, K, Ca and Ti. The overall pollution load index was found below one which indicates the perfection of soil. Calculated Enrichment Factor (EF) value for all heavy metals except Pb were found in significant enrichment, Zn and Sr were found in very high enrichment in the area. Based on the potential ecological risk index for Zn, Cu, Pb metals were found below thirty which indicates that these metals are posed low risk and Cr indicates moderate risk in the ecosystem. To understand the threat of heavy metal toxicity in the plant the bio-concentration factors (BCF) and translocation factor (TF) of heavy metals in leaves, shoots, and roots collected from the eastern coast of Bangladesh have been assessed as well. BCF and TF values were found below one which reflects the hyper-accumulation potentiality of these plants.

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1.25 Assessment of sediment samples collected from Halda river, Bangladesh

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

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1.26 Distribution of heavy metal in road dust collected from highway, Dhaka

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Road dust from three different highway roads of Dhaka were collected and analysed with EDXRF. The average concentration of the heavy metals was found in the order of Ca>K>Fe >Ti>Sr>Zr>Rb>Zn>Cu>Pb. The average concentrations are higher than their background value respectively. The highest value of Igeo found for Ti, which indicates the strongly polluted by this metal. The magnitudes of Enrichment Factors (EFs) showed that the area around Dhaka highway is low to moderately polluted especially by Cu and Ti. All the sampling sites have poor site quality as some of the site of the PLI is greater than one. Inter-elemental

relations showed that Ti and Sr are the contaminants, which may have similar anthropogenic origin; i.e. vehicle emission. The main exposure pathway of heavy metals to both children and adults is ingestion. The health risk is not in alarming zone for the general people of Dhaka City but non-carcinogenic risk for Pb can cause the largest threat to health in Dhaka city.

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1.27 Pollution levels of heavy metal in the aquatic environment of Buriganga river after shifting the Hazaribagh tannery complex

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The study reveals that the concentration of toxic metal in Buriganga river water and sediment is distributed in the sequence of Ca>Fe>Mn>Sr>Zn>Cu>Pb>Rb>As>Cr>Co>Ni and Ca>Fe>K>Ti> Sr>Zr>Rb>Zn>Pb> Cr>Cu>As>Ni, respectively. The I_{geo} values of Buriganga River sediment reveals that the sampling point 1 is moderately to strongly polluted by Pb; Sr is uncontaminated to moderately contaminated in all the sampling points and all the studied metals are at practically uncontaminated level. The degree of contamination (Cd) ranged from 8.64 to 15.29 which reveal that all sampling points are at moderate degree of contamination level. EF values for Sr, indicating moderately to extremely polluted, Pb lies extremely polluted in sampling point 01 and others exist in moderately polluted category. The rest of the metals are moderately polluted and mostly originated from the point source of pollution. The average index of potential ecological risk factors (RI) showed that Buriganga River has a low potential ecological risk due to heavy metal contamination. The pollution load index (PLI) values were exceed the baseline value indicates progressive deterioration of the sediment quality at sampling point S-1, S-2 and S-4. After the relocation of Hazaribag tannery, the pollution load in Buriganga river reducing from the previous year which is positive but still some sample points indicates progressive deterioration of the site.

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1.28 Energy detection in cognitive radio network under rayleigh Nakagami-*m* fading channels

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The performance of a Cognitive radio network depends on, how successfully the Secondary User (SU) can detect the present of Primary User (PU) and recognize the false alarm arises from interferences. In this research project, we determine the profile of probability of detection and probability of false alarm of a Secondary User under Rayleigh and Nakagami-*m* fading channels. Here, we use the combination of fading and Additive White Gaussian Noise (AWGN) as the impairments of the signal. We detect both the above parameters analytically and verified by Monte Carlo Simulation. The analytical and simulation results are found very closed to each other.In this project work, we evaluate the performance of cognitive radio network based on probability of detection and probability of false alarm. The received SNR is evaluated to provide $P_f \leq 8\%$ and $P_d \geq 80\%$ for Rayleigh and Nakagami-*m* fading channel. The analytical and simulation results are compared which provides 95% confidence level. The above work can be extended for chi-squired PDF where random variables are the square sum of Gaussian random variable, even for the case of weighted sum of random variable signal .Another further work can be inclusion of malicious user and observed of its impact on network performance.

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1.29 Health risk assessment of toxic heavy metals in dust particles of different schools in Dhaka City, Bangladesh

M. S. Rahman, A. Salam*, M. Ullah*, S. Akter, M. J. Kabir and Y. N. Jolly

Street dust sample were collected from seventeen different schools situated in Dhaka city, Bangladesh and most schools are on the side of the main road. Heavy metals, such as Pb, Cu, Mn, Zn, Cd, Ni, Cr which are found in street dust, have significant impact for environmental pollution. Elemental analysis in street dust was carried out using of X-ray fluoroscopy spectrometry (XRF) method. The average concentration of the studied elements are Ca (63988.82 mg/kg), Fe(23524.12 mg/kg), Ti (2484.87 mg/kg), Zn (439.68 mg/kg), Sr (264.37 mg/kg), Zr (150.74 mg/kg), Cr (109.97 mg/kg), Rb (92.78 mg/kg), Cu (77.99 mg/kg), Pb (40.86 mg/kg), Ni

(30.15 mg/kg) and As (21.60 mg/kg). We assess the heavy metals on the basis of contamination factor (CF) geo-accumulation (Igeo), enrichment factor, (EF), pollution load index, hazard quotient (HQ), hazard index (HI), carcinogenic risk (RI). The pollution load index of most of the sites is higher than 1, indicating the deterioration of road dust quality of Dhaka City due to anthropogenic emissions. Non-carcinogenic risk was not found in this study. Ni and Cr showed a little concern about the cancer risk. Salinity and organic matter were also determined in this study. Due to the rapid growth of population, heavy traffic and improper management are the main causes of high level concentration of heavy metals in the dust particle in Dhaka City.

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1.30 Understanding the fog water composition and sources at an island location (Bhola- Bangladesh)

M. S. Rahman, A. Salam*, K. Nahar*, K. J. Fatema, Y. N. Jolly and T. R. Choudhury

This study revealed that the average pH, EC, TDS, TOC of the collected fog water samples (18 samples; December, 2017 to February, 2018) were 7.03±0.2, 371.2±63 μS cm^{-1}, 235.8±128 ppm and 15.8±5.8 ppm, respectively. The average concentration of F^-, Cl^-, SO_4^{2-}, NO_3^-, HCO_3^-, Na^+, K^+, NH_4^+, Ca^{2+}, and Mg^{2+} were 77.7±38.5, 937±416.5, 725.24±383.9, 1002.4±562.2, 70±48.2, 733.8±205.3, 338.6±188.7, 562.5±402.9, 1147.4±616.2, 350±125.5 μeqL^{-1}, respectively. The concentration of the determined ions followed the sequence: $Ca^{2+}>NO_3^->Cl^->Na^+>SO_4^{2-}>NH_4^+>Mg^{2+}>K^+>F^->HCO_3^-$. The average concentration of Zn, Mn, Fe, Cu were 336±150, 272±123, 50±30, 23±15 μgL^{-1} while the concentrations of Cr, Pb and Ni were very low. The order of concentration of trace metals was Zn >Mn>Fe >Cu >Ni>Cr>Pb. The ratio of ∑cation to ∑anion was 1.07, indicating that alkaline constituents neutralize acidity. The recorded pH (on average pH=7.03±0.2) also confirm the ratio of ∑cation to ∑anion is neutral. The concentration of K^+ and NO_3^- were higher than many countries of the world but lower than China. Neutralization factor analysis showed that Ca and NH_4^+ were the major neutralization constituents of the fog water. Correlation analysis between different chemical species showed significant correlation among sea, soil and anthropogenic species. High enrichment factors of SO_4^{2-}, NO_3^-, Zn, Mn and Cu were good indication of anthropogenic sources. Percentage for source contribution of different species showed significant anthropogenic contribution of Cl^-(8.30%), SO_4^{2-}(84.02%) and NO_3^- (99.74%). The results suggested that fog water chemistry is strongly influenced by anthropogenic sources rather than natural and marine sources.

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1.31 Heavy metals contamination in sediment of Meghna river, Bangladesh

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Result of this study showed thatthe average concentration of the studied metals showed the following trend: Ca>K>Fe>Ti>Sr>Zr>Pb>Cu>Mn>Zn>Ni>As>Cr. The average metal levels did not show significant variations among study sites during rainy season. Spatial distribution and severity of sediment-associated contamination by heavy metals based on the newly developed indices ($mPEL_Q$ and $mERM_Q$) were in good agreement with existing pollution indices. Pollution load index (PLI), ptential contamination index (PCI), enrichment factor (EF), contamination factor (CF) and geo-accumulation index (I_{geo}) were also used to evaluate the sediment-heavy metal contamination, which generally indicated medium risk contamination of the investigated ecosystems. Potential contamination index (PCI) generally followed the sequence Sr>Pb>Fe>K>Zn>Ti>Zr>Ca>Cr. I_{geo} values showed that sediments are strongly contaminated with Ti and Pb and also moderately contaminated with As. Contamination factor (CF) and enrichment factor (EF) of the studied metals were generally followed the sequence of Ti>Pb>Cu>As>K>Ni>Sr>Fe>Ca>Zr>Zn>Cr>Mn. Pearson's correlation exposed that there is strong positive correlation between Ni and Zn; Cu and Ti; Zn and Ti.Spatial distributions of an eco-toxicological index based on mean probable eff ect level quotient ($mPEL_Q$) and mean effect range median quotient ($mERM_Q$) indicated that there was a 73% probability that the combination of the five metals was exerting a toxic stress in the Meghna River sediments. The contamination trends derived from the indices were consistent and took into consideration site specificity, toxicity and the effect levels (extreme effects guideline values) that support their reliability in evaluating contaminated aquatic ecosystems of Meghna River.

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

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Concentration of 6 heavy metals (i.e., Pb, Cu, Zn, As, Cr, Co) were studied in the soils around to proposed site of Ruppur Nuclear Power Plant Pabna, Bangladesh. To assess heavy metals contamination distribution due to industrialization, urbanization and agricultural activities. Soil samples were collected at depth of 5-9 inch in fifthteen station around RNPP. The concentration of Pb, Cu, Zn, and As were determine in the soil samples range from 61-863, 11-47, 93-165, and 7-12 mg/kg respectively. The concentration of Cr and Co is not found. The concentration of heavy metals in the soil display the following decreasing trend: Pb>Zn>Cu>As. The study proved that soil contamination in RNPP is not insignificant; risk assessment indicated that the carcinogenic risk is completely insignificant but the cumulative non-carcinogenic risk tends to became significant, mainly for children, since it approaches unacceptable values. There is no particularly dangerous single heavy metal, but their cumulative effect, expressed as Child Soil Ingestion Hazardous Index, is for concern. Concentration of toxic material of arsenic was found within the safe limit. Cupper was also safe the reference the world average value. When soil sample were collected from RNPP side soil do not show any significant population.

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1.33 Sources, factors, impacts and possible solutions to pollutants in the coastal region of Chattogram

M. S. Rahman, M. B. Hossain, M. Rahman, S. M. O. F. Babu, J. Kabir, S. Akter and Y. N. Jolly

Sediment and plant samples collected from ship breaking yard were analyzed to detect the level of heavy metal concentration and to evaluate their potential ecological risk. Deadly metals like Cr, Cu, As, Zn, Pb, Zr were tested by usingEpsilon 5 EDXRF Spectrometer System at Bangladesh Atomic Energy Commission (BAEC) chemistry division. The study result displayed the rate of pollution from heavy metals decreases in following order: Zr>Zn>Sr>Pb>Cu>Cr>As. Based on geo-accumulation index, contamination factor, the sediment of ship breaking site can be treated as unpolluted to moderately polluted with Zn, Zr but considerably polluted with Pb. The pollution load index values were below 1 refers the perfection of sediment. The Enrichment factor value (< 2) in all sampling sites, suggesting minimal enrichment expect for Pb. Based on the potential ecological risk index, the ship breaking area was posed to low risk to the environment. Correlation coefficient and principal component analysis revealed positive relationship among several metals, which indicates the sources of metals may be similar and anthropogenic. Phyto-remediation by the mangrove should be one of the best ways to protect this area.

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1.34 Effects of climate changes on dissolved heavy metal concentrations in water of coastal regions in Bangladesh

M. S. Rahman, S. M. O. F. Babu*, M. Rahman*, M. A. U. Palash*, Y. N. Jolly, B. A. Begum and T. R. Choudhury

The impacts of climate change on heavy metal contamination have been discussed qualitatively for marine/riverine ecosystems in literature. On the other hand, river water quality is important for ecological health. Therefore, objective of the study was to evaluate the heavy metal chemicals changes in water before and after monsoon. However, this study was conducted in Noakhalikhal estuary near the Sandip channel region, which is a coastal area situated near the Bay-of-Bengal, Bangladesh. It should be mentioned here that water of Sandip channel region is heavily used for irrigation, fishing, washing, aquaculture, dumping domestic waste and water-based transport. Water samples were collected using Van Dorn water sampler from 8 sites in triplicate fashion in pre-monsoon and post-monsoon. This study revealed that mean metal concentrations of water samples in the present study area were decreased in the following trend: Cr>Zn>Cu>Pb>Cd. The studied metals showed higher concentrations in respect of drinking water standard values of WHO. This study revealed that ecological risk calculation findings for water were one to four orders of magnitude lower than that of the low reference values in the guidelines, suggesting that heavy metal contamination and ecological risk needed not be a major concern for future pollution control and management

plans for the river, though there is still a need for heavy metal monitoring to prevent unnecessary risk. However, the studied heavy metal concentrations were significantly higher before the monsoon compared to the period after**.**

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1.35 Preliminary assessment of heavy metals in water and sediment in aquaculture ponds, Bangladesh

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Therefore, heavy metals such as Cr, Cu, Zn, Cd and Pb in water and sediment were analyzed of three fish farms of Noakhali district in Bangladesh to evaluate the heavy metals concentrations in aquaculture fish farm, and to assess intensity of contamination using Atomic Absorption Spectrophotometer (AAS) in chemistry division of Rapid Action Battalion (RAB), Dhaka, Bangladesh. In this study, Cr and Cd respectively showed the highest and the lower concentrations (mg/L) both in water and sediment showing Cr>Pb>Cu>Zn>Cd trend. This study also showed that the mean concentrations of all the heavy metals in the studied farms were almost within the safe limits of WHO, ADB with some exceptions. The intensity of contamination for sediment was evaluated using geo-accumulation index (I_{geo}) and contamination factor (*CF*). The calculated I_{geo} for Cr, Cu, Zn, Cd and Pb exhibited positive values and I_{geo} class: 0, indicating uncontaminated sediment quality. Significant positive correlation ($p < 0.05$) was observed in Cr-Cd (0.68) and significant negative correlation ($p < 0.05$) was observed between Cu and Cd (r = 0.75), Cr and Pb ($r = 0.73$) for waters. A significantly negative correlation was observed between Cu and Zn (0.67) in sediment samples, which denotes similar sources of the elements. From this study it has been suggested that the sediment of the area was found to be under low risk condition.

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1.36 Metal contamination in household air dust around EPZ industrial zone: an investigation based on multivariate statistics and spatial distribution

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A total 36 air dust samples were collected from Savar near Dhaka EPZ (export processing zone) industrial areas. Samples were analysed using X-ray Fluorescence analysis technique for K, Ca, Ti, Fe, Cu, Zn, As, Rb, Sr, Y, Zr, Pb, Cr, Ni detection. The chemical analysis was done in Chemistry division at Bangladesh Atomic Energy Commission, Dhaka. Results expressed that the value of Potassiam (K) ranged between 12033mgkg^{-1} to 34340mgkg^{-1}, Calsium (Ca) ion concentration ranged between 35390mgkg^{-1} to 95080mgkg^{-1}, Titanium (Ti) ranged between 2753 mgkg^{-1} to 5401 mgkg^{-1}, Iron (Fe) ion concentration ranged between 36080 to 171780, Copper (Cu) ion concentration ranged from 16mgkg^{-1}to 41 mgkg^{-1}, Zinc (Zn) ion concentration ranged from 561mgkg^{-1}to 5865 mgkg^{-1}, Arsenic(As) ion concentration ranged from 6 to 12 mg kg^{-1}, Rubidium (Rb) ion concentration ranged from 71 to 284 mg kg^{-1}, Stronsium (Sr) ion concentration ranged from 106 to 202 mg kg^{-1}, Yttrium (Yt) ion concentration ranged from 15 to 37 mg kg^{-1}, Zirconium (Zr) ion concentration ranged from 4668 to 14665 mg kg^{-1}, lead (Pb) ion concentration ranged from 202 to 785 mg kg^{-1}, Chromium (Cr) and Nickel (Ni) ion concentration were < 5.2 mg kg^{-1} and < 0.13 mg kg^{-1}. It was observed that investigation of indoor air quality contributed mainly to human health risk than that by inhalation. Results indicate that anthropogenic source of chemical in the studied area was the main source of chemical in those areas. Chemicals which are potentially harmful to both environment and human health are increasing day by day. So this research represented the kinds of source of industrial areas and possible health effect of these chemicals.

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1.37 Heavy metals emission from traditional and improved cooking stoves in Barishal, Bangladesh

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To assay the pollution stress in cooking stoves, trace and heavy metal concentrations from the emission of traditional cooking stoves (TCS) and improved cooking stoves (ICS) were determined. Six different samplings were collected on Teflon filters which using Air Metrics MiniVol sampler. Concentrations of several trace metals (e.g. Cr, Mn, Fe, Co, Ni) and heavy metals (e.g. Ga, Se, Rb, As, W) were determined with ICP-OES. The concentration of K and Fe were highest among the determined elements. The non-carcinogenic and carcinogenic metals showed excellent correlation which indicates that they might arise from the same source. Among the heavy metals correlation indicates they might come from other sources i.e.

crustal or industrial. The non-carcinogenic metal concentration increased in case of ICS. Enrichment factors also suggests that Fe, As, Cu, Pb might arise from same source as they have EF values around 1. The comparison with studies (local and international) studies suggests that air quality has not improved drastically by the installment of improved coking stoves.

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1.38 Adsorption of Cr (VI) on $ZnCl_2$ activated rice husk for waste water treatment purposes

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

Adsorption processes are being widely used by various researchers for the removal of heavy metals from waste streams. In recent years, the need for safe and economical methods for the elimination of heavy metals from contaminated waters has necessitated research interest toward the production of low cost alternatives to commercially available adsorbents. Therefore, there is an urgent need that all possible sources of agro-based inexpensive adsorbents should be explored and their feasibility for the removal of heavy metals should be studied in detail. The objective of this research is to study the utilization possibilities of less expensive adsorbents for the elimination of heavy metals from wastewater. Agricultural and industrial waste by-product such as rice husk has to be used for the elimination of Cr (VI) from waste water. In this study, the removal of Cr (VI) from aqueous solution by batch adsorption technique using $ZnCl_2$ Activated Rice Husk (ARH) adsorbent was investigated. The influence of pH, adsorbent dose, initial adsorbate concentration, contact time and particle sizes were studied. The physic-chemical properties of Rice Husk were studied using different characterization techniques such as Langmuir Adsorption Isotherm, Freundlich Isotherm and Kinetics of the adsorption process. Adsorption studies were carried out up to 5 hour to evaluate the effect of time on adsorption efficiency. The results of this study showed that adsorption of Cr(VI) by ARH reached to equilibrium after 90 minutes of the experiment and after that a little change of chromium removal efficiency was observed.The basic data obtained were interpreted kinetically by using second order rate kinetics. In all the cases the kinetics followed second order rate equation. Higher degree of coefficient of determination (0.997) was obtained for the pseudo-second-order kinetic model. Experimental data for the adsorbent was fitted to different isotherm models such as Langmuir, Freundlich isotherms equation. Langmuir isotherm model best fitted the adsorption equilibrium, implying that the adsorption occurred through monolayer formation on the surface of adsorbents via chemical interactions.

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1.39 Accumulation of metals in anectarivore and saprophagous insect of two areas (Curzon-Anondobazar area and Savar Hemayetpur) around Dhaka city

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

The rapid developments of technology and industrialization with the emission of deleterious heavy metals occurring in the world today largely affect on the Mother Nature along with her all living beings. Due to their high potential of accumulation in food chains; human beings are also at risk of toxic effects such as endocrine disruptions. The purpose of this research was to quantity the accumulation of heavy metals within some organs of anectarivore and saprophagous insects as an alarm signal to minimize the rate of pollution of heavy metals in the environment. In the present research two insects named honey bee (*ApisIndica*) and blow fly (*Chrysomyamegacephala*) from two areas (Curzon, Savar)were used to observe the amount of accumulation ofdifferent metals (viz.As, Cd, Cr, Cu, Fe, Hg, Mn, Ni and Zn). Impact of this metal pollution on their body organs (viz. brains and ovaries) were performed by histo-pathological observations. The detection of the metals was performed by using Flame (Cu, Zn, Mn, Fe and Ni), Hydride-generation atomic absorption spectrometry (As), Cold Vapor AAS (Hg) and Graphite-Furnace Atomic Absorption Spectrometry (Cr, Cd, Pb). The analyses of metals show that in honey bee, Cr, As and Hg were highest in Savar tannery zone, Cd and Pb were highest in honey bee from Curzon area. In case of blow fly the concentrations of As, Cr, Hg were also highest in SavarHemayetpur area and Cd was highest in Curzon-Anondobazar area whereas the concentrations of lead was below the detection limit (<0.06 µg/kg) in both areas. The histo-pathological study revealed that in case of blow flies, the saprophagous insect, ovaries were affected much, whereas in honey bees, nectarivore insect the metals were mostly deposited inthe brain.

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1.40 Coastal and marine biodiversity in Bangladesh: assessing heavy metals on ecological impact

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

Heavy metals are persistent in the environment and are subjected to bioaccumulation in food chains. The main aim of study is to assess the concentrations of heavy metals (Pb, Cd, and Cr, As, Hg, Cu, Zn, and Ni) in insects, chicken and fish with an attempt to establish a baseline data of their concentration and also the histopthological lesions in the coastal areas (Cox's Bazar and Teknaf) in Bangladesh. The insects, chicken and fish samples were collected and taken for hot plate digestion technique (HNO_3). The concentrations of heavy metals were analyzed using Atomic Absorption spectrophotometer (AAS). In this study heavy metals in different organs of insects (whole insects and brain), chickens (brain, gizzard, liver and muscle) and fishes (brain and muscles from different portions of body as well as whole body) were evaluated and estimated the prevalence of histopathological lesions in the brain of insects, fish and chicken. Constant monitoring is needed to record with a view to minimize the risk of health of the population and the detrimental impacts on the aquatic ecosystem as well as the whole environment. The concentrations of toxic elements Pb, Cd, Cr, As , Hg,Cu,Ni, Zn were found to be in the range from 60-3495, 10-365, 347-9019 ,80-289, 20-59.39, 20-70770, 500-17300,1800- 137600 μg/kg, respectively; in the samples collected from Cox's Bazar and Teknaf areas. The levels of heavy metals were compared with standards of WHO/FAO.

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1.41 Bioaccumulation and potential sources of heavy metals contamination in fish, insect and chicken of Buriganga and Turag river bank areas in Dhaka city

T. R. Choudhury, I. Jahan*, M. M. Hoseen, M. A. Maksud, S. R. Khan, L. N. Lutfa and B. A. Begum

The impacts of trace metals on ecosystems are now such a major concern worldwide that ecological risk assessments are used widely to support legislation, policy and regulation. Excessive pollution of Buriganga and Turag River has already deteriorated the glory of Dhaka city in the past few decades. Physical, chemical and biological conditions and surrounding environment are in the most undesirable state. The purpose for this research work is to access the concentration of heavy metals in different phylum chordate, Galliform and to find out their impact on ecological system on the Buriganga and Turag River river bank area of Dhaka city. In this study eight types of heavy metals such as arsenic (As), cadmium (Cd), chromium (Cr), copper (Cu), lead (Pb), mercury (Hg), nickel (Ni) and zinc (Zn) were considered to evaluate the effect on different selected organs in insect, fish and chicken samples from two study areas; Buriganga and Turag River bank sides. Concentration of these heavy metals was determined by AAS. This study showed that arsenic, copper, lead, zinc were relatively higher in samples from Turag area. Concentration of Cadmium (155.53 ug/L) in blowfly was higher in the samples of Buriganga area. Chromium was found in the highest amount in brain of sarputi fish (272.65 ug/L) from Buriganga area. Histological study were also performed and showed that these heavy metals were accumulated in different body parts in insect, fish and chicken samples and may cause harmful effect on their physiological functions. Through food chain human might be exposed with these heavy metals in their different body parts and ultimately causes several physiological disruptions.

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1.42 Impact of heavy metals on biodiversity of environments and possible ecological risks evaluation in northern part of Bangladesh

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

In recent years, heavy metals contamination has attracted global attention owing to its toxicity, abundance and persistence to the environment.The main objectives of this study is to determine heavy metals concentrations in fish, meat, insect and to assess the ecological risk of contamination by heavy metals through food consumption in northern part of Bangladesh. In this study insect, fish and chickens were used to observe the impact of heavy metals pollution on their body organs. The accumulation of metals, such as cadmium, chromium, lead, arsenic, mercury, copper, zinc, nickel in adult insects, fish and chicken have been evaluated in the two study areas, namely Gaibandha sadar upazila and Saghata upazila. The detection of the metals were performed by using Flame,Hydride-generation and Graphite Atomic Absorption Spectrometry methods as well as their impacts on brains through histological process collected from the study areas.

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1.43 Hydro-geochemical investigation of groundwater quality and human health risk: a case study of Noakhali Sadar Upazilla, Noakhali, Bangladesh

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

Fresh water has been recognized as one of the fundamental elements of the sustainability of the planet's key life-supporting functions; it is interwoven in almost all processes and constituents of natural ecosystems and human societies.The objective of the present investigation is to estimate the hydro-geochemical characterization, water quality evaluation in terms of drinking and irrigation purposes and possible consumptive human health risks associated with groundwater quality of Noakhali Sadar Upazilla, Noakhali, Bangladesh and to examine by integrated approach; a set of hydro-chemical analysis, water evaluation indices, heavy metal pollution indices along with Geographical Information System (GIS) and multivariate statistical techniques. Thirty groundwater samples were analyzed for the intended purposes. The concentration of major cations (Li^+, Na^+, NH_4^+, K^+, Mg^{2+} and Ca^{2+}) and anions (F^-, Cl^-, NO_2^-, SO_4^{2-}, Br^-, NO_3^- and PO_4^{2-}) were determined by Ion Chromatography (IC) system and the concentration of heavy metals (Fe, As, Zn, Mn, Cu, Pb and Cd) has been analyzed using Atomic Absorption Spectrophotometer (AAS). From the present study, it is found that most of the studied hydrochemical parameters (Temperature, EC, TDS, Cl, Mg, Fe, As, Mn and Pb) exceeded the limits stipulated by different national and international standards for drinking water. The analyzed data indicated that the groundwater samples are mainly Na-Cl type. Principal component analysis (PCA) results revealed that the natural geogenic sources (Rock–water interaction (weathering) in shallow unconfined aquifers, dissolution of fluro-pyrites, fluorite and various silicate bearing minerals and cation-anion exchange) were the major factors influencing the groundwater quality of the study area. Furthermore, the results of PCA are validated using the cluster analysis (CA) and correlation matrix (CM) analysis. Based on the groundwater quality index (GWQI), it is found that all the groundwater samples belong to unsuitable for drinking as 90% of the samples exceeded the permissible GWQI limit. The results of irrigation water quality index including sodium adsorption ratio (SAR), magnesium absorption ratio (MAR), total hardness (TH), kelly's ratio (KR), residual sodium carbonate (RSC), permeability index (PI) and sodium percentage (Na %) suggested that 65% of the sample locations are unfit for irrigation purposes. Spatial analysis of Groundwater Quality Index (GWQI), Heavy Metal Pollution Index (HPI), Heavy Metal Evaluation Index (HEI) and Degree of Contamination ($C_{d)}$ vary significantly around the study area. Strong, moderate, and weak spatial dependences were found in the study area.

In addition, mean Hazard Quotient (HQ) and Hazard Index (HI) values based on As, Cd, Zn, Cu and Pb imply that the groundwater poses substantial health risks for both adults and children. The carcinogenic risk among adults and children due to As and Pb is very high and high, respectively in the study area. Thus, considering all the above findings, it can be concluded that groundwater quality of NoakhaliSadarUpazilla is unsuitable for drinking and slightly suitable for irrigation purposes and the groundwater of the study area was characterized by high salinity possessing high level of non-carcinogenic as well as cancer-risk (As and Pb) vulnerability of the local community.

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1.44 Investigation of groundwater quality and its sustainability approach for drinking and agricultural use in the south-eastern part of coastal region in Bangladesh

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The south-eastern part of Bangladesh is vulnerable to natural disasters, and groundwater quality of this region has been deteriorating day-by-day as well as is an alarming issue in recent days as it is directly related to human health. The major objective of this investigation is to examine the groundwater quality and its sustainability using integrated approach of geochemical methods, water evaluation indices, several pollution indices, multivariate statistics and Geographical Information System (GIS). This study investigates groundwater quality in the Subarnachar coastal region of Noakhali district, BangladeshA total 30 groundwater samples were collected from the tube wells of predetermined sites of the study area and analyzed for the intended purposes. The concentration of major cations (Li+, Na+, NH4+, K+, Mg2+ and Ca2+) and anions (F, Cl-, NO2-, SO42-, Br-, NO3- and PO42-) were determined by Ion Chromatography (IC) system and the

concentration of heavy metals (Fe, As, Zn, Mn, Cu, Pb and Cd) has been analyzed by means of Atomic Absorption Spectrophotometer (AAS). Comparison results with national and international standards shows that above investigated parameters of the groundwater are below standard limit. Hydro-geochemical investigation results revealed that about 67% water type is Na-Cl which is also proved by physico-chemical properties that indicates alkaline water. Principle Component Analysis (PCA) shows the chemical composition of groundwater of the study area is affected by salinity intrusion. In addition, the results of PCA are validated using the cluster analysis (CA) and correlation matrix (CM) analysis. Moreover, spatial distribution locates the heavy metals and other properties of the groundwater quality indices. Based on the groundwater quality index (GWQI), it is evident that 60%, 30% and 10% samples are poor, good and unsuitable, respectively for drinking purpose. The results of irrigation water quality index including sodium adsorption ratio (SAR), magnesium absorption ratio (MAR), total hardness (TH), kelly's ratio (KR), residual sodium carbonate (RSC), and sodium percentage (Na %) suggested that salinity hazard may affect the irrigation activities. However, Heavy metal Pollution Index (HPI), Heavy metal Evaluation Index (HEI) and Degree of Contamination (Cd) is lower in the study area. This study reveals that the groundwater quality is moderately suitable for both drinking and irrigational purposes.

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1.45 Assessment of impurities in different commercial available branded and non- branded consumer salts in Bangladesh

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Salt is a vital substance for all of us. Currently about 5% of the total salt extracted in the world is destined only for human consumption. Most of the sodium in our diet comes from salt, or sodium chloride. Consuming salt that contains adulterants like $MgSO_4$, $NaSO_4$ and $CaSO_4$ may cause serious health problems like damaging the kidney, nausea and swelling the body. Investigation of impurities in salt is very important to evaluate the quality of consumer salt. The main aim of this study is to investigate the adulterants in different commercially available branded and non-branded salts. Ion Chromatography (IC) is a simple and fast method for separation and determination of ions based on their charge. Anion and Cation in salt samples were determined by using IC system. Flame Atomic Absorption Spectrometry (FAAS) was used to determine the heavy metals (Pb, Cd, and Hg) in salt samples. In the present study it is found that the average NaCl content in branded and non-branded salts are 73.5% and 62.73% respectively. BSTI-standard of NaCl content in salt is minimum 97%. Brand-1 salt and Brand-2 salt contain 93%and 94% of NaCl respectively. Brand-3 salt contains the lowest NaCl content (62%). Sulfate is a major impurity in common salt. Brand-2 salt and Brand-4 salt contain 16.55 g/kg and 10.104 g/kg of sulfate (SO_4^{2-}) which is very high content. BSTI-standard of lead (Pb) content in salt is 0.002 g/kg. Brand-5 salt, Non-brand-1 salt and Brand-6 salt contain 0.728 g/kg, 0.661 g/kg, and 0.629 g/kg of lead (Pb) which is so much higher compared to BSTI-standard of lead content in salt. Sulfate content in non-branded salts are higher than that in the branded salts. The other parameter (Ca^{2+}, Mg^{2+}, NO_2^-, Fl^-, Br^-) determined in the salt samples exceeded the limits stimulated by different standards of salt content. From the present investigation, it has been revealed that both the branded and non-branded salts contain high content of impurities. Consuming these salts may lead to serious health hazards to the consumers.

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1.46 Determination of heavy metals in water, sediment and health risk implication of the south-western coastal region in Bangladesh

T. R. Choudhury, T. Islam*, M. Z. Chowdhury, S. R. Khan and B. A. Begum

Bangladesh is considered as one of the most climate vulnerable countries in the world. Inthe south-western part, it has large coastal linewith highly susceptible areas to sea level rise. Water andsoil salinity are regular hazards for many parts speciallysouth east, central, and southwestpart of the coastal areas of Bangladesh arebeing affected by different uses of water including drinking, irrigation, household, fisheries, and functioning of the ecosystem. The objective of the study is to assess water qualityproblems subsist in groundwater and surface water systemsin Bangladesh, especially in its southwestern coastalregions, where

salinity is extreme problematic issue. Contamination of heavy metals in Water is regarded as a global crisis with a large share in developing countries like Bangladesh. Nine heavy metals such as Lead (Pb),Chromium (Cr), Cadmium (Cd),Mercury (Hg),Arsenic (As),Iron(Fe),Manganese(Mn),Zinc (Zn) and Nickel (Ni) in sediment and water were investigated from South-Western coastal region in Bangladesh. The decreasing trend of metals were observed in water as Fe>Mn>Zn>Pb>As>Cd>Cr>Cu>Hg and in sediment were Fe>Mn>Zn>Cr>Ni>Pb>As>Cd>Hg. The ranges of Pb, Cd, As, Fe, Zn and Mn of heavy metals in water were 13-25,1-1.5, 2.05-3.084, 254.11-1154.71, 10.4-29.61, 219.22-250.92 µg/L respectively and in sediments were 10.5-17,0.1-0.5,22.67-30.37,47.42-59.19,0.009-0.034,1.87-2.76,20844-25499,403.55-513.22,19.2-27.5 mg/kg respectively.The concentration of the surface water samples were not exceeded the permissible limits. The data monitored have been used to compute heavy metal pollution index using weighted arithmetic mean method and the proposed pollution index (HPI) and heavy metal evaluation index (HEI) seem to be applicable in the assessment of overall water quality with respect to heavy metal pollution which indicates the water to free from heavy metal pollution. The pollution load index (PLI) and contamination factor (CF) were used to assess the human health risks posed by heavy metals through sediments.

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1.47 Phytochemical analysis of Cantharanthus Rose*us* (Nayontara) leaf using by GC-MS technique

A. R. M. Tareq, S. Islam*, R. Sultana, A. K. M. A. Ullah and S. B. Quraishi

Catharanthusroseus is an important medicinal plant of the apocynacae family. The aim of the present study is to investigate the phytochemical analysis of methanol extract of Nayontara (Artocarpusheterophyllus) leafsfor feasibility study of raw materials production in medication purposes. The sample was collected, washed and dried in oven over 60°C, than it was crushed for homogenization. After crushing about 5.0g sample was taken into 50mL methanol and refluxed for 2.5 hours.The study conducted the presence of carotenoid, terpinoid, phenolic, alchoholic, ketonic, sterol, organic acid and alkane derivatives in collected Nayontara leaf. It also has been studied to identify all above mentioned compounds by using Gas chromatography-Mass spectroscopy (GC-MS) technique. The identified compounds were: Alcoholic 42.64%, Ketonic 10.14%, Sterol 23.03%, Terpinoid 2.675, Carotinoid 1.82%, Alkane 3.43 and organic acids 2.43%. The major copound is 3',6-dihydro-, (3.beta.,5.beta.,6.alpha.,22.xi.,23.xi.)-Cyclopropa [5, 6] -33-norgorgostan-3-ol (17.98%).

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1.48 Polycyclic aromatic hydrocarbons (PAHs): an approach of some selected tea bands

A. R. M. Tareq, J. Afsana*, R. Sultana, A. K. M. A. Ullah and S. B. Quraishi

Polycyclic aromatic hydrocarbons (PAHs) are a group of organic environmental pollutants which can significantly influence the quality of tea. The objective of this present study is to evaluate the status of PAHs contamination in different types of teas and expansion of the human health risk assert by such substances, so we have considered twenty-one tea samples. Three of them were black tea, four of them were green tea and fourteen of them were herbal teas. The PAHs in them were identified and quantified by a gas chromatography-mass spectrometry (GC-MS) technique. All the samples were contained with naphthalene in the range of 230 – 6020 µg/kg and the range of three samples (Kazi&Kazi Green tea, Taaza Black tea and Seylon Black tea) was below the detection level. Herbal and green teas contained more naphthalene than black teas. The two most other carcinogenic compounds chrysene in and benzo(a)anthracene were also measured in Kazi and Kazi green tea, Finlay geen tea, Kazi and Kazitulsi tea, Tulsipati masala tea and Kazi&Kazi lemongrass tea. The sum of PAH_3, Benzo(a)pyrene, Chrysene, and Benzo(a)anthracene in all tea samples was measured as 28.61 µg/kg whereas EC (2006) set the maximum levels for PAH_3 as 12 µg/kg. So, the present data indicating that these mentioned three tea samples were more carcinogenic for human consumption.

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1.49 Green synthesis of bio-molecules encapsulated magnetite nanoparticles and their bio-medical applications

A. K. M. A. Ullah, S. Saha, A. R. M. Tareq, M. M. Hosen, S. B. Quraishi and A. K. M. F. Kibria

Magnetite (Fe_3O_4) nanoparticles (NPs) were synthesized through green synthesis route utilizing *Citrus limon* peel extract that acted as an efficient stabilizer and capping agent of the NPs. Two types of Magnetite NPs

were synthesized using 50 mL and 90 mL lemon peel extracts (LPE) respectively. The X-ray Diffraction (XRD) analysis showed that the particles were crystalline with cubic inverse spinel structure for both cases and the crystallite sizes were found to be about 21.6 ± 6.1 nm and 32.1 ± 7.5 nm respectively. The surface morphology of the NPs was investigated by Field Emission Scanning Electron Microscopy (FESEM) which showed that NPs were spherical. Elemental analysis of the NPs was carried out with Energy Dispersive X-ray (EDX) Spectroscopy and it indicated the elemental signature of the presence of iron, oxygen and carbon in the NPs. The Fourier Transform Infrared Spectroscopy (FTIR) analysis showed that the capping agents of the NPs contained the functional groups alcohol, alkene and alkyne. The thermal stability of Fe_3O_4 NPs was investigated using Thermo Gravimetric Analysis (TGA). The percentage of weight loss was of about 18% and 10% respectively for two types of synthesized NPs as found from TGA which. The NPs were superparamagnetic in nature with zero coercivity and zero reminiscent magnetization which was observed using a Vibrating Sample Magnetometer (VSM). Moreover, the synthesized Fe_3O_4 NPs were exposed to two types of cell, HeLa cell which is carcinoma cell and Vero cell which is normal cell, and from the cytotoxicity analysis it was evidenced that bio-molecules encapsulated Fe_3O_4 NPs were more toxic on cancer cells than normal cells convincing their deliberate use as an anti-cancer agent.

1.50 Cost effective green synthesis of silver nanoparticles using some medicinalleaf extracts and evaluation of their antibacterial activityagainst multidrug-resistant strains

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

Drug resistance is one of the most serious, threatening, and widespread problems in all the developing countries. Silver nanoparticles are presently viewed as a viable alternative to antibiotics and seem to have a high potential to solve the problem of the emergence of bacterial multidrug resistance. The objectives of the present study were to find out a green synthesis route for the silver nanoparticles using different medicinal leaf extracts and observe theirantibacterial activity against multidrug-resistant strains. Hence, silver nanoparticles were synthesized from the reduction of silver nitrate using aqueous leaf extracts of three medicinal plants-Tulsi (*Ocimum tenuiflorum*), Neem (*Azadirachta indica)* and Durba (*Cynodon dactylon*) at the same route. The X-ray diffraction study clearly depict the successful synthesis of silver nanoparticles. The observation of antibacterial activity of the synthesized silver nanoparticles against multidrug resistant strains is under investigation.

Clinical Chemistry

1.51 Serum zinc level on 60 pediatric patients suffering from Wilson's disease

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

Wilson's Disease (WD) is a rare autosomal recessive geneticdisorder of copper (Cu) metabolism resulting to the accumulative deposition of Cu in liver and brain impairing the normal functions of the affected organs. A combination of various parameters is required to establish a diagnosis as no single finding is adequate for diagnosis of WD. In the present study, attempt has been taken to find out a relationship of serum zinc level on pediatric patients suffering from Wilson's disease. Samples were collected from 45 patients and serum zinc level was determined using atomic absorption spectrometer (AAS). The study is under progress.

1.52 Utility of serum copper level extermination in patient suffering from Alzheimer's diseases

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

With the increasing life expectancy of people in the world including Bangladesh, dementia patients are being increased. Alzheimer's disease is the most common cause of dementia. Increasing evidence suggests that oxidative stress has a key role in late-onset sporadic forms, which are the majority of Alzheimer's disease cases. Metals, such as zinc, copper, iron are likely involved in the neurodegeneration of Alzheimer's disease. Copper can catalyze a flux of reactive oxygen species that can damage functional and structural macromolecules in brain. Most studies found association of high serum copper level with Alzheimer's disease but also some studies did not. This study aims to evaluate the relationship between serum copper and cognitive impairment of Alzheimer's patients and its relationship with the severity of the disease. In the present study, **a** total of 28 males and 20 females with mean age of 66.20 ± 9.42 years, 22 male and 20 females with mean age of 63.54 ± 9.74 years constituted as case and control groups, respectively. So, there are no significant difference between case and control regarding age (P> 0.05) and sex (P>0.05). The mean of

serum copper in case and control groups were 0.95 ± 0.37mg/L versus 0.92 ± 0.25 mg/L (P > 0.05). The present study found that serum copper levels are non-significantly higher in patients with AD than control group, however, it did not show a significant relationship with severity of dementia. So, our suggestion was to perform a study work including total serum copper level, serum ceruloplasmin level and free serum copper level comparing between a large Alzheimer's Disease patients' group and age, sex matched apparently healthy control group to understand the copper dishomeostasis in Alzheimer' Disease.

1.53 Association of α-amylase activity with glycated hemoglobin and trace elements in impaired glucose metabolism

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

Diabetes Mellitus (DM) is a metabolic disorder arising from absolute or relative deficiencies in insulin secretion and/or insulin action or both resulting in impaired carbohydrate, lipid and protein metabolism. Pancreatic α-amylase enzyme is involved in starch metabolism, which has an effect in blood glucose level and may influence glycated hemoglobin level. Trace minerals are required in small quantities for growth, development and various physiological activities. Impaired trace elements level is associated with metabolic disturbances. In the present study it was aimed to investigate the glucose level, α-amylase activity, HbA1c and trace elements (Zn, Cu, Mg) in study groups and observes correlations among these variables. The mean value of α-amylase was slightly higher (p=0.615) in diabetic patients in comparison with control group. Cu level was significantly increased (p< 0.05), while Zn andMg levels showed no significant difference in diabetics compared to control subjects. HbA1cwas observed to have significant negative correlation (r =-0.394, p<0.05) with α-amylase in diabetic patients. α-amylase also showed slight negative correction with fasting and 2-hourglucose level in diabetic patients. This may reflect exocrine-endocrine axis of pancreas to correct glucose level in diabetic patients. α-amylase exhibited no noteworthy relation with Zn and Mg in both of our study groups. Cu level is increased in hyperglycemia. α-amylase demonstrated insignificant negative correlation with Cu in study groups. HbA1c had inverse relation with Zn in diabetic group, which indicates decrease in Zn level in uncontrolled diabetes. Cu showed slight positive correlation with HbA1c in control subjects but had negative correlation in diabetics. HbA1c had considerable positive correlation (r=0.452, p=0.06) with Mg in control subjects but negligible correlation in diabetic patients.α-amylase is associated with abnormal glucose level and HbA1c. So, this enzyme activity may be used as a parameter to predict diabetic risk. Further study of α-amylase activity in relation with glucose level may help to clarify the organization of exocrine-endocrine relationship of pancreas in regulating blood glucose level in metabolic complications. Altered trace elements level has a complex role in pathogenesis of diabetes. Further exploration of trace elements to illustrate their role in diabetes pathogenesis and mechanism of altered level of trace minerals after onset of diabetes may provide a treatment strategy for diabetes.

2. Manpower Development and Training Programme

Title of the event	Date	Place	No. of Participant
Training Programme On the Use, Maintenance, Trouble-shooting and Applications of Atomic Absorption Spectrophotometer (AAS)	21-26 July 2018	Chemistry Division, Atomic Energy Centre Dhaka (AECD), Dhaka 1000.	20

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

Name of the person	Title of the event	Organizer	Date	Place
Dr. S. B. Quraishi	Bangladesh Chemical Congress-2018	Dhaka University	17-18 Oct. 2018	Dhaka University
	National Conference on Physics- 2019	BPS	07-09 Feb. 2019	Dhaka University
Dr. Y. N. Jolly	Bangladesh Chemical congress-2018	Dhaka University	17-18 Oct. 2018	Dhaka University
	International Conference on Electronics and ICT	BES & BAEC	25-26 Nov. 2018	Atomic Energy Centre, Dhaka

Name of the person	Title of the event	Organizer	Date	Place
	International Seminar cum Workshop by OWSD-BD	SIDA	10 Nov. 2018	BAEC
	National Conference on Physics- 2019	BPS	07-09 Feb. 2019	Dhaka University
Dr. M. S. Rahman	International Conference on Climate Change	Dhaka University	01-03 Mar. 2019	Dhaka University
	International Conference on Physics (ICP- 2019)	Department of Physics, DU	07-09 Feb. 2019	Dhaka University
	International Conference on Electronics and ICT	Bangladesh	25-26 Nov. 2018	Atomic Energy Centre, Dhaka
	39th Annual Conference of Bangladesh Chemical Society	Bangladesh Chemical Society (BCS)	17-19 Oct. 2018	Department of Chemistry, DU
M. J. Kabir	Bangladesh Chemical congress-2018	University of Dhaka	17-18 Oct. 2018	Dhaka University
	International Conference on Electronics and ICT	BES & BAEC	25-26 Nov. 2018	Atomic Energy Centre, Dhaka
	National Conference on Physics- 2019	BPS	7-9 Feb. 2019	Dhaka University
Engr. S. Akter	Bangladesh Chemical congress-2018	University of Dhaka	17-18 Oct. 2018	Dhaka University
	International Conference on Electronics and ICT	BES & BAEC	25-26 Nov. 2018	Atomic Energy Centre, Dhaka
	International Seminar cum Workshop by OWSD-BD	SIDA	10 Nov. 2018	BAEC
	National Conference on Physics- 2019	BPS	7-9 Feb. 2019	Dhaka University
K. M. Mamun	Bangladesh Chemical congress-2018	University of Dhaka	17-18 Oct. 2018	Dhaka University
	International Conference on Electronics and ICT	BES & BAEC BAEC	25-26 Nov. 2018	Atomic Energy Centre, Dhaka
	National Conference on Physics- 2019	BPS	7-9 Feb. 2019	Dhaka University
Dr. T. R. Choudhury	Bangladesh Chemical congress-2018	University of Dhaka	17-18 Oct. 2018	Dhaka University
	International Conference on Electronics and ICT	BES & BAEC	25-26 Nov. 2018	Atomic Energy Centre, Dhaka
	International Seminar cum Workshop by OWSD-BD	SIDA	10 Nov. 2018	BAEC
A. R. M. Tareq	International Conference on Electronics and ICT-2018	BES BAEC	25-26 Nov. 2018	AECD
	Bangladesh Chemical Congress (BCC2018),	BCS	17-19 Oct. 2018	DU
	5th Conference of Bangladesh Crystallographic Association -2019	BCA	25-26 Jan. 2019	DU
R. Sultana	International Conference on Electronics and ICT-2018	BES	25-26 Nov. 2018	AECD
	Bangladesh Chemical Congress (BCC2018)	BCS	17-19 Oct. 2018	DU
	National Conference on Physics 2019	BPS	7-9 Feb. 2019	DU

4. Service Rendered and Revenue Income

Name of service	No./quantity of sample	Revenue income
Analysis of Urinary Copper	2396	1736800/-
Analysis of Serum	35	52,500/-
Analysis of Shrimp/fish/Crab	40	2,43,300/-
Analysis of Milk	455	9,10,000/-
Analysis of Beef, Mutton, Liver, Kidney /Meat	32	2,95,250/-
Analysis of Fish feed	18	1,75,500/-
Analysis of Water	15	76,500/-
Analysis of potato	2	4,000/-
Analysis of Food supplement	1	2,000/-
Analysis of Fruits & vegetables	30	87,995/-
Analysis of Arsenic in hair	106	1,06,000/-
Analysis of Gold & silver	246	5,87000/-
Analysis of sand	1	3400/-
Analysis of Human blood (pb)	5	15000/-
Analysis of NaCl	1	11000/-
Analysis of phosphate		11000/-
Analysis of STPP	1	11000/-
Analysis of Soft shell crab	1	5000/-
Analysis of breaded Crum bed	1	11000/-
Essential Oils	2	3000/-
Total	3337	43,47,245/-

Electronics Division, AECD

Objective

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

Activities

1. Design and Development Work(s)

1.1 Design and development of a tesla coil for wireless power transfer

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

In this work, a Tesla coil which is the main part of transmitter component in wireless electricity device has been developed with a view to demonstrate how magnetic induction is coupled to perform a wireless power transfer. In addition, the construction of winding coils of the Tesla coil would be the great effects in order to provide electricity to supply a load without wires in distances. Tesla coil consists of two coils, one is primary and another is secondary. Primary coil is wound around the secondary coil and hence due to law of electromagnetic induction a voltage will be induced in the secondary coil. Since the number of turns in the secondary coil is very large than primary coil, the output voltage of secondary becomes very high. Actually,

Tesla coil induces high density flux that produces high frequency, high voltage and low alternating current and can glow a normal CFL bulb approximately with a distance of 10 cm without any conductive physical connection. Thus the objective to describe the ability of winding coils construction in order to provide electricity to supply a load without wires in distances is achieved. Moreover, it is observed that the number of turns is an important parameter that should be considered in order to ensure the apparatus of wireless power transfer function efficiently.

1.2 Design and development of a low cost microcontroller based inductance meter

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

Inductors are an essential part of any analogue circuit and often it is needed to measure their values in inductance for the proper design of these circuits. However, a traditional multimeter can measure the essential electric properties such as voltage, current, resistance, capacitance etc. The only property that still remains difficult to measure by a traditional multimeter is inductance. In contrast, there are some special multimeters that can measure inductance and capacitance, but they are costly. The goal of this work is to design and develop a low cost microcontroller based inductor meter.

Inductance meter presented in this work is based on the principle of the natural resonance of an inductor-capacitor (LC) tank circuit. The system is developed by converting the natural sinusoidal waveform of the LC circuit to a square wave using a comparator and by calculating the period of one cycle of the square wave through microcontroller. From the period of one cycle of the square wave, it can easily be calculated the frequency of LC resonant circuit. The value of that calculated frequency and a known capacitor is applied in the formula of resonant frequency of the LC circuit, to measure the inductance of an unknown inductor. Design circuits were studied to perform efficient and precise time measurements. The system is low cost as it is made of an Ardunio Uno board with a LCD display and simple circuit components. Another advantages of this system is that one can instantaneously change inductors and measure its value without any hassle. The developed system is tested in the laboratory and it is working properly in the wide range of 50 μH to 5 mH.

1.3 Design and development of a microcontroller based dc-dc boost converter

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

Boost converter, also known as chopper, operates by periodically opening and closing an electronic switch. The operation of the electronic switch or also known as power switches in the boost circuit needs a driver. Instead of using the driver and pulse generator to produce the Pulse Width Modulation (PWM), microcontroller is programmed to generate the PWM for the power switches which offers more flexibility and less complexity on the circuit design. The basic components of the boost converter designed in this work are a power semiconductor switch (MOSFET), an inductor, a diode, capacitors and microcontroller programed pulse width modulator (PWM) controller. The circuit is operated on continuous current mode, because the output has to produce a constant high voltage in both on-state and off-state of power switches. In this case, at the end of on-state of power switches the current in the inductor never go zero and continuously supply the current for the output. A prototype boost converter has been developed and tested in laboratory. It is observed that this boost converter can produce an output dc high voltage of about 500 V from an input dc voltage of 5 V with a step up factor of 100.

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

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

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 is 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 are optimized. Now, the quad-copter is capable of flying around 1000 meters line of sight area. With the set value of control parameters, flying test of the designed quad copter is performed for 100 meter line of sight area at the play ground of BAEC housing, Banani,

Dhaka. 1000 meter flying test cannot be performed due to the lacking of enough line of site area at BAEC housing play ground. This is an ongoing work. Next target is to add a GM-survey meter with wireless data transmission facility to the UAV.

1.5 Design of a wireless data transmission and reception system for GM- survey meter used in radiation monitoring and data logging

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

This work is intended for designing a reliable data communication system between ground base station and UAV (Unmanned Arial Vehicle) data acquisition unit. A wireless data transmission and reception system is designed using wireless communication module (Xbee Pro S2B) for transmitting radiation data from UAV to ground base station. As the designed UAV is capable of flying 1000 meters line of sight from ground base station, the transmitter used for radiation data transmission system should have the ability to transmit data at least 1000 meters. Transmitting range of Xbee Pro S2B is 1600 meters, which satisfy the design requirement. A GM-survey meter with wireless data transmission capability is designed using Xbee Pro S2B and attached with the UAV for acquiring and transmitting radiation data. Another Xbee Pro S2B is interfaced with a microcontroller along with display and data logger for receiving, displaying and logging the radiation data transmitted from the survey-meter attached with UAV. The data reception system is attached with the ground base station. This is an ongoing work.

1.6 Radiation detection and measurement by using a robotic system

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

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

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

S. Sattar, M. J. Alam*, A. S. Mollah**, M. A. Rahman, M. A. A. Mamun and M. Begum

Geiger Muller is one of the oldest and low cost detectors used for radiation monitoring in and around radiation facilities. The GM detector can detect alpha particles, beta particles, X-ray and Gamma ray based on radiation interaction mechanism. As GM detector is a counter, it is unable to provide the energy level of the radiation. Though the response of the detector is energy dependent. Specially for different energy level of gamma ray, the accuracy of the detector response varies. A robotic system with GM detector based survey meter has been developed for monitoring radiation level. As part of the performance analysis of the system, energy response of the detector has determined experimentally with different radio nuclides. The following energies are considered for the study: i) 662 keV from Cs-137, ii) 1250 keV (avrg) from Co-60 and iii) 1274 keV from Na-22. Based on the study it is found that the response of the GM detector is energy dependent within ±25%. In order to reducing the energy dependency, different filter can be used for energy compensation.

*Bangladesh University of Engineering and Technology, Dhaka, **Military Institute of Science and Technology, Dhaka

1.8 Study and development of microcontroller based high voltage power supply

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

In this project, design, development and simulation of a microcontroller based high voltage power supply (HVPS) have been presented. The HVPS consists of microcontroller(μC) based oscillator (9.09 KHz, 96.36%D, 5V), transistor driver circuit, ferrite core high voltage (HV) transformer and quadruple voltage multiplier circuit. The PIC16F84A μC with 20 MHz crystal generates 9.09 KHz, 96.36%D, 5V signal which has been used as a input for transistor 2N2222A driver coupled with ferrite core HV transformer. Thereafter, the transformer's secondary voltage has been multiplied by a quadrupler circuit. A multi-turn potentiometer has been used to control the output voltage to a required level. An assembly language program based on MPLAB IDE has been developed for generation of the oscillator signal.

In this research, The design and verification of the PIC µC based high voltage power supply (HVPS) in Proteus 7.7 simulation platform has been completed successfully. The designed system is cost effective, simple and reliable in operation. The HVPS has been tested repeatedly and its performance was found satisfactory.

1.9 Study and development of PIC microcontroller-to-PC communication via USB

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

In this project, authors attempt to describe a study and development of PIC Microcontroller-to-PC communication via USB. The Microchip FSUSB Framework utilized the PIC18F4553 with 20MHz crystal. PortB pin RB4 has been used as Bootloader and RD0 & RD1 as the status indicator. Moreover, RC5 and RC4 of PortC have been used as USB D+ and D-. Firmware tools consist of Mplab IDE, Mplab C18 Compiler, Driver, FSUSB Framework v2.6 and Microsoft Visual Stadio (Visual C/C Sharp). Demonstration and Development of a complete USB2.0 communication solution has been verified by using USB Device – CDC – BASICDEMO software on Proteus 7.7 simulation platform.

An elaborate study and method of development for PIC Microcontroller-to-PC communication via USB has been presented in this research. The Block diagram representation, schematic diagram which includes complete simulation model of the primitive hardware used in the Microchip FSUSB framework on Proteus 7.7 simulation platform and demonstration also have been presented. Demonstration and Development of a complete USB2.0 communication solution has been verified by using USB Device – CDC – BASICDEMO software.

1.10 Design and development of a microcontroller based automatic mains changeover system

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

Design, development and simulation of an automatic electrical mains changeover system (EMCS) using PIC Microcontroller (µC) has been presented in this project. The System consists of 18-pin DIP Package Enhanced Flash Microcontroller PIC16F84A with 4MHz crystal used as main processor, two switching transistors, two relays and low voltage power supply (LVPS). The electrical mains control signal output at RB0 and RB2 of PortB actuate two switching transistors which drive two relays to operate the loads depending on the availability of mains or backup power source. An assembly language program based on MPLAB IDE has been developed to control the operation of the system.

The design and verification of the PIC µC based electrical mains changeover system (EMCS) in Proteus 7.7 simulation platform has been completed successfully. The designed system is cost effective, simple and reliable in operation. The EMCS has been tested repeatedly and its performance was found satisfactory.

1.11 Study of health and safety at nuclear installations

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

A study of health and safety at nuclear installations has been presented in this project. The main provision in this context is to set up Health and Safety Commission and Health and Safety Executive to administer regulations concerning the health and safety of persons at work, and of other persons who may be put at risk by the activities of persons at work. Man-made sources of radiation including occupational exposures from nuclear reactors and accelerators, natural radiation sources also have been presented. Summary of UK Regulations has been presented as well.

An ample study about the health and safety at nuclear installations has been presented in this research. Firstly, the contributor of man-made radiation sources has been presented elaborately. Secondly, the contributor of natural radioactive sources has been provided. Significant radiological parameters and regulations along with main provisions for them also have been presented. This study would be helpful for guidelines regarding detecting radiation hazards which will ensure health and safety of the workers and public.

*Physical Science Division, Bangladesh Atomic Energy Commission, Dhaka

1.12 CNC System for customized electronic system design

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

The application of Computer Numerical Control (CNC) system is increasing day by day because this system has added a new dimension in research and industrial field. A CNC system controls machine tools

automatically under the control of a computer as an alternative to a human operator. This paper deals with the applications and impact of CNC system for customized electronic system design. In almost all electronic system, Printed Circuit Board (PCB) is the core component that can be fabricated using the CNC system. To fabricate PCB using CNC machine, at first target PCB layout is designed using PCB design software, for example, Eagle. Then, the PCB layout is converted to G-code format which is readable by the CNC machine. Reading the G-code instruction, CNC system automatically finds out the drill holes and layout to complete the PCB fabrication process. Not only PCB fabrication, this system can be used for making plastic and metallic box for proper packaging of the customized electronic system. Also, various mechanical parts for robotic design can be made using this system. Thus, the CNC system plays a vital role in customized electronic system design. The implementation of the system has been completed and now it is working properly.

1.13 Design and development of a low cost digital trainer board

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

Digital logic circuits form the basis of all digital hardware which plays a prominent role in most electronics devices used in industrial and domestic application. A digital logic circuit comprises a network of logic gates. Each logic gate performs a very simple function and more complex operations are realized by connecting gates together. A number of sophisticated modules exist for building a variety of digital logic circuit. However, these are usually very expensive. Our proposed module will reduce the cost by using different logic gate (ICs) which are available. Other devices used on the module include switches, capacitors, resistors, transistors, diodes, 7- segment display, probe and PCB cards. The ICs containers provide input and output pins or connections which are interconnected on circuit board to form complete devices. The inputs and outputs are numbered and each number refers to as an external pin on the IC container. A ground connection and a positive power voltage are both required from each container. The developed system is tested in the laboratory and it is working properly.

1.14 A Convenient cost-effective hand glove system for paralyzed people using fork spring switches

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

Challenges are faced to accomplish everyday tasks by the people suffered from Hemiplegia that causes complete paralysis of half part of the body. Various wearable systems were developed for reducing their dependency on others. However, all of these systems are expensive to afford and difficult to use. A prototype hand glove system using fork spring switches has been developed for these people to control home appliances and to inform others in an emergency through GSM module. In this system, gestures are detected from each finger of the person suffered from Hemiplegia by fork spring switch with the help of flexible wire. With the change of gesture, data is sent wirelessly to the Arduino based driving circuit to control home appliances and the GSM module. The usage of low-cost fork spring switches for detecting gestures makes the system cost-effective as well as easy to use by the people. The developed system is tested in our laboratory.

2. Repair & Maintenance and Renovation Works

During the period major instruments (scientific, industrial and nuclear) of AECD have been repaired. The major instruments include repair Digital Earth Tester, Portable Air Sampler, Air Sampler Analyzer, Electronic Balance, Digital PBX-Board, Panasonic 16SLC(2), Power Supply, LCD monitor, LED Monitor, CVT, CCTV, CRT Monitor, Computers, (System Unit with software installation), Printers, Intercom Systems. The Division has been successfully maintaining the Intercom Systems of AECD. The system contains Digital PBX-Board, Panasonic 16SLC having 96 lines and Panasonic D1232, having 16 lines.

Table: Type and number of repaired instruments

Type of the instruments	Name of the user	Qty.
Scientific, Nuclear and Analytical	AECD	06
Computer (System Unit with software installation)	AECD	17
Monitor	AECD	04
UPS (Uninterruptible Power Supply)	AECD	02
Intercom System (Line & Set)	AECD	12

3. Manpower Development and Training Program

Title of the event	Date	Place	No. of participant
Industrial Attachment Training program	03Feb. - 03April 2019	ED, AECD	23

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

Name of the participant	Title of the event	Organizer	Date	Place
Engr. M. Begum	First Concrete Pouring Ceremony of 2nd Unit, RNPP	NPED	July 14, 2018	Pabna
	Capacity Build-up of Nano and Nano-Bio Technology Laboratory of Materials Science Division Atomic Energy Centre Dhaka Entitled Project	MSD	06 Sept., 2018	Dhaka
	International Conference on Electronics and ICT-2018	BES & BAEC	25 - 26 Nov. 2018	Dhaka
	Training Program on "Radioactivity Monitoring Instrument" under FNCA Program	IE	13 - 17 Jan. 2019	Dhaka
	AECD - IES Seminar on "Ensure Safety, Reliability & Efficiency of Industries Through NDT"	NDT	06 Feb. 2019	Dhaka
	International Conference on Physics-2019	BPS	07 - 09 Feb. 2019	DU
	Special Seminar on "Nanotechnology and Early Medical Diagnostics by the State of the Art Technology - An Introspection"	MSD	17 Feb. 2019	Dhaka
	59th Convention: Engineers for Leadership in Sustainable Infrastructure Development in Bangladesh	IEB	01 - 05 March, 2019	Dhaka
H. Akhter	Capacity Build-up of Nano and Nano-Bio Technology Laboratory of Materials Science Division Atomic Energy Centre Dhaka Entitled Project	MSD	06 Sept. 2018	Dhaka
	International Conference on Electronics and ICT-2018	BES & BAEC	25 - 26 Nov. 2018	Dhaka
	AECD - IES Seminar on "Ensure Safety, Reliability & Efficiency of Industries Through NDT"	NDT	06 Feb. 2019	Dhaka
	International Conference on Physics-2019	BPS	07 - 09 Feb. 2019	DU
	Special Seminar on "Nanotechnology and Early Medical Diagnostics by the State of the Art Technology - An Introspection"	MSD	17 Feb. 2019	Dhaka
Engr. M. N. Islam	First Concrete Pouring Ceremony of 2nd Unit	NPED	July 14, 2018	Pabna
	Capacity Build-up of Nano and Nano-Bio Technology Laboratory of Materials Science Division Atomic Energy Centre Dhaka Entitled Project	MSD	06 Sept. 2018	Dhaka
	International Conference on Electronics and ICT-2018	BES & BAEC	25 - 26 Nov. 2018	Dhaka
	Training Program on "Radioactivity Monitoring Instrument" under FNCA Program	IE	13 - 17 Jan. 2019	Dhaka
	AECD - IES Seminar on "Ensure Safety, Reliability & Efficiency of Industries Through NDT"	NDT	06 Feb. 2019	Dhaka
	Special Seminar on "Nanotechnology and Early Medical Diagnostics by the State of the Art Technology - An Introspection"	MSD	17 Feb. 2019	Dhaka
	59th Convention: Engineers for Leadership in Sustainable Infrastructure Development in Bangladesh	IEB	01 - 05 March, 2019	Dhaka

Name of the participant	Title of the event	Organizer	Date	Place
Dr. M. A. A. Mamun	International Conference on Electronics and ICT-2018	BES	25 - 26 Nov. 2018	AECD
	Follow-up Training Course (FTC) on "Radioactivity Monitoring Instrument" under FNCA Program	BAEC and JAEA	13 - 17 Jan. 2019	IE, AERE
	International Conference on Physics-2019	BPS	07 - 09 Feb. 2019	DU
	Special Seminar on "Nanotechnology and Early Medical Diagnostics by the State of the Art Technology - An Introspection"	MSD	17 Feb. 2019	Dhaka
M. A. Rahman	International Conference on Electronics and ICT-2018	BES	25 - 26 Nov. 2018	AECD
	International Conference on Physics-2019	BPS	07 – 09 Feb. 2019	DU
	Capacity Build-up of Nano and Nano-Bio Technology Laboratory of Materials Science Division Atomic Energy Centre Dhaka Entitled Project	MSD	06 Sept. 2018	Dhaka
	Special Seminar on "Nanotechnology and Early Medical Diagnostics by the State of the Art Technology - An Introspection"	MSD	17 Feb. 2019	Dhaka
Engr. S. Sattar	International Conference on Electronics and ICT – 2018	BES	25 - 26 Nov. 2018	AECD
	International Seminar cum workshop	OWSD	10 Nov. 2018.	BAEC
M. T. Khatun	Capacity Build-up of Nano and Nano-Bio Technology Laboratory of Materials Science Division Atomic Energy Centre Dhaka Entitled Project	MSD	06 Sept. 2018	Dhaka
	International Conference on Electronics and ICT-2018	BES	25 - 26Nov. 2018	AECD
	Follow-up Training Course (FTC) on "Radioactivity Monitoring Instrument" under FNCA Program	BAEC and JAEA	13 - 17Jan. 2019	IE,AERE
	AECD - IES Seminar on "Ensure Safety, Reliability & Efficiency of Industries Through NDT"	NDT	06 Feb. 2019	Dhaka
	Follow-up Training Course (FTC) on "Reactor engineering Course (REC) -2019"	BAEC and JAEA	10 - 28 Feb. 2019	TI , AERE
	International Conference on Physics-2019	BPS	07 - 09 Feb. 2019	DU
	PCB Design Workshop	DU	02 - 03 May, 2019	DU
A. B. Siddik	Capacity Build-up of Nano and Nano-Bio Technology Laboratory of Materials Science Division Atomic Energy Centre Dhaka Entitled Project	MSD	06 Sept. 2018	Dhaka
	International Conference on Electronics and ICT-2018	BES	25 - 26 Nov. 2018	AECD
	Follow-up Training Course (FTC) on "Radioactivity Monitoring Instrument" under FNCA Program	BAEC and JAEA	13 - 17 Jan. 2019	IE,AERE , Savar
	AECD - IES Seminar on "Ensure Safety, Reliability & Efficiency of Industries Through NDT"	NDT	06 Feb. 2019	Dhaka
	International Conference on Physics-2019	BPS	07 - 09 Feb. 2019	DU
	PCB Design Workshop	DU	02 - 03 May, 2019	DU
M. U. Safia	International Seminar cum workshop	OWSD	10 Nov. 2018.	BAEC
	PCB Design Workshop	DU	02 - 03 May, 2019	DU
J. Akter	PCB Design Workshop	DU	02 - 03 May, 2019	DU
B. Sarker	PCB Design Workshop	DU	02 - 03 May, 2019	DU

5. Collaboration Work

Collaboration with different National & International universities.

Experimental Physics Division, AECD

Objective/Introduction

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

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

Activities/Program(s)

1. Research and Development Work(s)

1.1 Preparation and characterization of CdTe thin film by thermal evaporation technique

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

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

Current progress: CdTe thin films of thickness 50nm, 100nm, 200nm & substrate temperature S_T = 200^0C/40nm, 300^0C/60 nm & annealing temperature A_T = 100^0C with annealing time 1 hour is prepared by thermal evaporation method. All the samples were characterized by UV-VIS-NIR spectroscopy and the structural properties were confirmed by using XRD

1.2 Synthesis ZnSe thin film using thermal evaporation method

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

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

Current progress: ZnSe thin films of thickness 30nm, 40nm, 70nm, 90 nm & substrate temperature S_T = 290^0C & annealing temperature A_T =300^0C 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 were obtained from the XRD data using different models. ZnSe films thickness were calculated and also confirmed by SEM data.

1.3 Preparation and characterization of CdTe thin film by thermal evaporation technique

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

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

Current progress: CdTe thin films of thickness 50nm, 100nm, 200nm & substrate temperature S_T = 290^0C & annealing temperature A_T =300^0C with annealing time 1 hour is prepared by thermal evaporation method. All the samples were characterized by UV-VIS-NIR spectroscopy and the structural properties were confirmed by using XRD

1.4 Synthesis ZnSe thin film using thermal evaporation method

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

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

Current progress: ZnSe thin films of thickness 30nm, 40nm, 70nm, 90 nm & substrate temperature S_T = 290^0C & annealing temperature A_T =300^0C 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 were obtained from the XRD data using different models. ZnSe films thickness were calculated and also confirmed by SEM data.

1.5 Optical and structural characterization fabricated by thermal vapor deposition technique of ZnSe thin film

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

Objective: Analysis of optical & structural properties of ZnSe thin film.

Current progress: ZnSe thin films of thickness 600nm, 700nm, 750nm, 1200 nm & substrate temperature S_T = 200^0C & 300^0C were prepared by thermal evaporation method. ZnSe thin films were prepared on readily available soda-lime glass substrate by thermal evaporation technique. X-ray diffraction data confirmed the polycrystalline nature of the films. The most important parameter optical band gap estimated on this research work. Structural parameters such as crystallite size, stress, strain, dislocation density were obtained from the XRD data using different models.

1.6 Synthesis and characterization of undoped and Cu doped CdS thin film by spin coating method

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

Objective: Analysis of CdS and Cu doped CdS thin film.

Current Progress: CdS and 0%, 5%, 9%, Cu doped CdS thin films are deposited on glass substrate at r. p. m = (2000, 5000)/30 sec & Annealing temperature 150℃ for 30 minute and 1 hour. UV measurements of these films were completed and Phase analysis of the doped and undoped was done by XRD. SEM confirmed the morphological structure of the films. One MSc thesis paper is completed.

1.7. Optoelectronic characterization of Copper (Cu) doped Zinc Oxide (ZnO) nanoparticles and thin film

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

Objective: To observe the effect of Cu on ZnO nano particle and thin film and also measure the parameters of these samples.

Current Progress: Zinc Oxide (ZnO) and Copper (Cu) doped ZnO nanoparticles were synthesized by chemical precipitation method and thin films were deposited by chemical bath deposition technique. Zinc acetate ($ZnC_4H_6O_4$) and cupric nitrate [$Cu(NO_3)_2$] were used as the precursor material. Isopropanol (C_3H_8O) and Monoethanolamine (C_2H_7NO) were used as solvent and stabilizer respectively. All samples were annealed at 400℃ for 1 hour as minimum annealing temperature for ZnO crystallinity is 400℃. The effect of Cu doping on composition, structural properties and optical properties of ZnO and Cu doped ZnO nano particles were investigated. Synthesized nano particles showed good structural properties after annealing. The samples were characterized by X-ray diffraction (XRD), Scanning electron microscopy (SEM), Fourier-transform infrared spectroscopy (FTIR), Energy dispersive spectroscopy (EDS), UV-Vis NIR Spectroscopy and Bandgap measurement. FTIR spectra confirm the presence of ZnO and Cu doped ZnO nanoparticles in the samples. Before and after annealing, XRD data confirmed the hexagonal structure of the synthesized nanoparticles and thin films which is in accordance with the SEM image. Particle Size and strain were estimated using Debye-Scherrer. Average size of the particles was found to be in the range 16 to 62 nm. The size distribution of nanoparticles was also observed from SEM images. ZnO nanoparticles have diffused reflectance of about 77% and Cu doped ZnO nanoparticles have diffused reflectance in the range of 62% - 64% which indicated that with the doping concentration increment diffuse reflectance tends to decrease. For 4 samples band gaps were determined by Kubelka-Munk function and reported as 3.05 eV, 2.76 eV, 2.4 eV and 2.25 eV respectively. As the crystal size got smaller due to increasing doping concentration bandgap also shows a reduction in its value.

1.8 Investigation of the structural, morphological and optical properties of Sn-doped CdSe thin films by chemical bath deposition method

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

Objective: To observe the effect of Sn on CdSe thin film and measure the parameters of this film.

Current Progress: The effects of undoped and Sn doped concentrations on the optical, structural and morphological properties of CdSe films are observed. The thin films of undoped CdSe and 5%, 10% and 15% Sn-doped CdSe have been grown on glass substrates using CBD at 70^0C temperature for 2 hours with annealing temperature 100^0C & time 1 hour. From X-ray diffraction patterns it was found that cubic phases

preferred orientation along 111 plane. Thickness of all samples were measured and found near 202 to 205nm. The optical transmittance, absorbance and band gap of these films were determined using UV-VIS-NIR Spectrometry. It was also observed that the band gap decreases with increasing Sn doping concentration. FTIR spectra confirmed the successive formation of Cadmium Selenide (CdSe) and Sn doped Cadmium Selenide (CdSe) thin film samples. One M.Sc thesis paper is completed.

1.9 Effect of Fe on CdSe thin film using chemical bath deposition technique

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

Objective: Analysis of Fe effect on CdSe thin film.

Current Progress: CdSe and 0%, 5%, 7% and 10% Fe doped CdSe thin films are deposited on glass substrate by CBD at substrate temperature S_T = 70^0C for 2 hours & annealing temperature A_T =100^0C for 60 min. XRD data confirms the degradation of thin films. FTIR spectra confirmed the presence of Cadmium Selenide (CdSe) and Fe doped cadmium Selenide (CdSe) in the sample. Transmittance, Reflectance, absorption co-efficient, extinction co- efficient, reflectance has been measured. One M. Sc thesis paper is completed.

1.10 CdS thin film preparation and characterization by chemical bath deposition

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

Objective: Deposition & characterization of CdS thin film.

Current Progress: CdS thin films are deposited on glass substrate by CBD at substrate temperature S_T = 60^0C for 2 hours. The structural analysis was performed by XRD. The deposited CdS thin film was a cubic phase with small nano crystalline grains. 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. The optical properties were investigated by UV-VIS-NIR spectroscopy analysis. These studies have all owed us to establish a standard set of conditions for the fabrication of homogeneous and continuous very thin CdS films.

1.11 Synthesis and characterization of CdS single crystal by chemical bath deposition technique

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

Objective: Synthesis & characterization of CdS single crystal.

Current Progress: Synthesis and growth of Cadmium Sulfide (CdS) single crystal produced by very easy and low cost Chemical Bath Deposition technique. In this study single crystal of CdS were grown up in room temperature and from aqueous solution by CBD technique at 60℃ temperature for 2 hours using Cadmium Cloride ($CdCl_2$), Ammonia water (NH_4OH), Thiourea [$CS(NH_2)$] and Distilled water as solvents respectively. It was observed that the Cadmium Cloride and Ammonia water form a complex species of $[Cd(NH_3)_4]_2$ to slow release of Cd^{2+} metal ion mode in crystal. Structure analysis of CdS single crystal was carried out by X-ray diffraction technique. Scanning Electron Microscopy (SEM) was used to Characterized the surface morphology and EDX (a analysis tool of SEM) used for elemental analysis which confirmed all the element present in the CdS single crystal. The FTIR spectrum confirms the existence of Cadmium Sulfide compound and water molecules in the samples. In this observation CBD method producing dispersive and crystalline CdS single crystals in the aqueous phase would have important applications because it provides hydrophilic crystals and is environmentally friendly. Others measurement and analysis of the parameters are going on.

1.12 Synthesis and characterization of CdS nano powder by chemical bath deposition technique

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

Objective: Synthesis & characterization of CdS nano powder.

Current Progress: Synthesis of Cadmium Sulfide (CdS) nano powder produced by very easy and low cost Chemical Bath Deposition technique. In this study nano powder of CdS were sintered in various temperature such as 100^0C, 300^0C, 500^0C . Nano powder was formed at room temperature and from aqueous solution by CBD technique at 60℃ temperature for 2 hours using Cadmium Cloride ($CdCl_2$), Ammonia water (NH_4OH), Thiourea [$CS(NH_2)$] and Distilled water as solvents respectively. Structure analysis of CdS nano powder was carried out by X-ray diffraction technique. Others measurement and analysis of the parameters are going on.

1.13 CuSe thin film synthesis and characterization by chemical bath deposition method

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

Objective: Deposition & characterization of CuSe thin film.

Current Progress: CuSe thin films are deposited on glass substrate by CBD. Thin films were prepared at room temperature for 4 hours. Analysis of the parameters is going on.

1.14 CdZnS thin film synthesis and characterization by chemical bath deposition method

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

Objective: Deposition & characterization of CdZnS thin film.

Current Progress: CdZnS thin films on different ratio of Cd and Zn are deposited on glass substrate by CBD. Thin films were prepared at 80℃ temperature for 30 min. & annealing temperature $A_T = 150^0$C for 60 min. Analysis of the parameters are going on.

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

Name of the participant	Title of the event	Organizer	Date	Place
Dr. K. M. A. Hussain	First Concrete Pouring Ceremony of 2nd Unit, RNPP	NPED	14 July, 2018	Pabna
	First Research Coordination Meeting (RCM) on the Coordination Research (CRP) for Advancing Radiation Detection Equipment for Detecting Nuclear and Other Radioactive Material out of Regulatory Control in Beijing, China	China	03-07 Sept., 2018	Beijing, China
	International Conference on Material Science and Semiconductor Devices	Dept. of EEE	7-8 Sept., 2018	University of Dhaka
	Conference on Electronics and ICT-2018	ICT	25-26 Nov., 2018.	AECD
	AECD- IES Seminar on "Ensure Safety, Reliability & Efficiency of Industries Trough NDT"	NDT	06 Feb., 2019	AECD
	National Conference on Physics	BPS	07-09 Feb., 2019	Dhaka University
	Seminar on "Internet of things"	Ministry of NST	4 March, 2019	Dhaka
Dr. M. T. Chowdhury	First Concrete Pouring Ceremony of 2nd Unit, RNPP	NPED	14 July, 2018	Pabna
	Seminar on Capacity Build-up of Nano and Nano-Bio Technology Laboratory of Materials Science Division Atomic Energy Centre, Dhaka Entitled Project	MSD	06 Sept., 2018	Dhaka
	International Conference on Material Science and Semiconductor Devices	Dept. of EEE	7-8 Sept., 2018	Dhaka University
	Conference on Electrical Engineering and Information & Communication Technology	ICCEEICT	13-15 Sept., 2018	MIST, Dhaka

Name of the participant	Title of the event	Organizer	Date	Place
	Conference on Electronics and ICT-2018	BES & BAEC	25-26 Nov., 2018	AECD
	Seminar on "Living robotics, and new field of research"	Ministry of NST	20 Dec., 2018	Dhaka
	AECD- IES Seminar on "Ensure Safety, Reliability & Efficiency of Industries Trough NDT"	NDT	06 Feb., 2019	AECD
	National Conference on Physics	BPS	07-09 Feb., 2019	Dhaka University
	Special Seminar on " Nanotechnology and Early Medical Diagnostics by the state of the Art Technology-An Introspection"	MSD	17 Feb., 2019	Dhaka
	Seminar on "Internet of things"	Ministry of NST	4 March, 2019	Dhaka
J. Parvin	Conference on Electronics and ICT-2018	BES & BAEC	25-26 Nov., 2018.	AECD
	National Conference on Physics	BPS	07-09 Febr., 2019	Dhaka University
	Special Seminar on "Nanotechnology and Early Medical Diagnostics by the state of the Art Technology-An Introspection"	MSD	17 Feb., 2019	Dhaka
F. T. Z. Toma	Seminar on Capacity Build-up of Nano and Nano-Bio Technology Laboratory of Materials Science Division Atomic Energy Centre, Dhaka Entitled Project	MSD	06 Sept., 2018	Dhaka
	Conference on Electronics and ICT-2018	BES & BAEC	25-26 Nov., 2018	AECD
	Follow-up training Course (FTC) on "Nuclear and Radiological Emergency Preparedness Course"	BAEC & JAEA	25 Nov. 06 Dec.	AERE, Savar
	Seminar on "Living robotics, and new field of research"	MOST	20 Dec., 2018	Dhaka
	AECD- IES Seminar on "Ensure safety, Reliability & Efficiency of Industries Trough NDT"	NDT	06 Feb., 2019	AECD
	National Conference on Physics	BPS	07-09 Febr., 2019	Dhaka University
	Special Seminar on "Nanotechnology and Early Medical Diagnostics by the state of the Art Technology-An Introspection"	MSD	17 Feb., 2019	Dhaka
	Seminar on "Internet of things"	MOST	4 March, 2019	Dhaka

3. Collaboration Work(s)

The Division has good collaboration with teachers and research students of

- Department of Physics and Department of Electrical and Electronic Engineering, University of Dhaka (for 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 Chattogram (M.S. thesis)
- Department of Glass and Ceramic Engineering (BUET)

Health Physics Division, AECD

Objective

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 & imported/exportable foods (except Chattogram 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

To fulfill the objective of this division various programmes have been taken on Research & Development (R&D) activities and Rendering service works on i) imported/exportable food stuffs ii) individual monitoring service and iii) gross alpha & gross beta measurement in water samples. National & International collaboration works and human resource development through academic programmes are also performed.

Activities

1. Research and Development Work(s)

1. 1 Survey of background radiation levels throughout Bangladesh

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

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

Current progress: During this reporting period, measurement of background radiation level has been carried out regularly in and around Dhaka city on monthly basis. In this study, calibrated beta-gamma survey meter was used with Global Positioning System (GPS) for pointing the location. The average background radiation level was found from 0.11 to 0.20 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, 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), Materials 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 digital survey meter Gamma Scout. 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 (0.45 - 2.25) μSvh^{-1}, (0.20 – 0.40) μSvh^{-1}, (0.45 –4.00) μSvh^{-1} and (0.16-0.22) 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, Z. Hossain and A. Joydhar

Objective: To determine the radionuclides and their concentration in rain water of AECD campus, Mohammadpur and Tongi area.

Current progress: During the reporting period, 24 rain water samples were collected from AECD campus, Mohammadpur and Tongi area. The activity concentration of radionuclides ^{238}U, ^{232}Th and ^{40}K were determined by Gamma Spectrometry System consists of High Purity Germanium (HPGe) Co-axial detector coupled with multichannel analyzer. No artificial radionuclide was observed in any of these samples.

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

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

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

Current Progress: Total 48 Imported food samples were collected from local market viz. Babul store-Rupnagar, Mirpur-5, Lovely store- Mirpur-11, Bhaia General Store- Mirpur-06, Bismillah General store-Mirpur-02. 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 procedure and analyzed for gamma emitting radionuclides. No artificial radionuclide was observed in any of these samples.

1.5 Radiation and radioactivity monitoring of Zinc Oxide (ZnO) material in the container no. (1) FSCU8152565 (2) SEGU5278924 (3) TCNU4422191 (4) TGBU5496964 (5) XINU8014423 at Chattogram Megaport, Bangladesh

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

Objective: The purpose of the present work is to provide technical service for the inspection of the above containers containing ZnO using digital survey meter Gamma Scout to find out the radiation dose rate and to collect samples for the measurement of radioactivity concentrations using High Purity Germanium gamma ray spectrometry system (HPGe) at Health Physics Division of Atomic Energy Centre Dhaka.

Current progress: 187 bags were found containing Zinc Oxide in five containers at custom house of Chattogram mega port. The radiation workers involved in this work wore TLD and Personal Electronic Dosimeters (PEDs) for personal dose record. The dose of the radiation workers were found nominal. Samples were collected from 17 bags of four containers (these bags showed comparatively high dose rate). High Purity Germanium gamma ray spectrometry system (HPGe) was used to detect radioactivity concentration of radionuclide present in Zinc Oxide samples (collected from the Chattogram mega port) at Health Physics Division of Atomic Energy Centre, Dhaka. The counting time for the samples was 50000 seconds. Artificial radionuclide Cesium (^{137}Cs) was detected in all 17 samples. Activity concentrations of ^{137}Cs of collected 15 samples were found within exemption level but 02 samples exceed the exemption level which is set by the Nuclear Safety and Radiation Control (NSRC) Rules-1997 and International Atomic Energy Agency (IAEA) Safety Standards- General Safety Requirements (GSR) Part 3.

1.6 Radiation and radioactivity monitoring of compound of Zinc Oxide in the container No. XINU8128489 at Chattogram Mega Port, Chattogram

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

Objective: The purpose of the present work is to provide technical service for the inspection of the above containers containing ZnO using digital survey meter Gamma Scout to find out the radiation dose rate and to collect samples for the measurement of radioactivity concentrations using High Purity Germanium gamma ray spectrometry system (HPGe) at Health Physics Division of Atomic Energy Centre Dhaka.

Current progress: 37 bags were found containing Zinc Oxide in one container at custom house of Chattogram mega port. The radiation workers involved in this work wore TLD and Personal Electronic

Dosimeters (PEDs) for personal dose record. The dose of the radiation workers were found nominal. Samples were collected from 12 bags of the same container (these bags showed comparatively high dose rate). High Purity Germanium gamma ray spectrometry system (HPGe) was used to detect radioactivity concentration of radionuclide present in Zinc Oxide samples (collected from the Chattogram megaport) at Health Physics Division of Atomic Energy Centre, Dhaka. The counting time for the samples was 50,000 seconds. Artificial radionuclide Cesium (^{137}Cs) was detected in all 12 samples. Activity concentrations of Cesium (^{137}Cs) from collected 08 samples were found within exemption level but 04 samples exceed the exemption level which is set by the Nuclear Safety and Radiation Control (NSRC) Rules-1997 and International Atomic Energy Agency (IAEA) Safety Standards- General Safety Requirements (GSR) Part 3.

1.7 Assessment of natural and artificial radionuclides in powdered milk sample commonly consumed in Bangladesh

M. M. Kabir*, M. M. M. Siraz, S. Pervin, A. F. M. M. Rahman**, M. I. Hosan*, S. Banik and S. Yeasmin

Objective: To determine the activity of Radio-nuclides present in foodstuffs which are directly inhaled or transferred along the food chain to the human body, which would elevate the dosage in the body.

Current progress: The activity concentration of natural and artificial radionuclides has been studied and evaluated for 16 powdered milk samples collected from local markets in Dhaka city, Bangladesh by using a High Purity Germanium (HPGe) detector. The activity concentrations of ^{226}Ra, ^{232}Th, and ^{40}K in milk samples ranged from 6.94 ± 2.15 Bqkg^{-1} to 25.48 ± 3.86 Bqkg^{-1} with a mean value of 14.15 ± 3.85 Bqkg^{-1}, 2.7 ± 1.87 Bqkg^{-1} to 14.19 ± 2.51 Bqkg^{-1} with a mean value of 6.36 ± 2.44 Bqkg^{-1} and 16.253 ± 13.725 Bqkg^{-1} to 275.308 ± 13.98 Bqkg^{-1} with a mean value of 93.52 ± 14.7 Bqkg^{-1} respectively. No artificial radionuclide (^{137}Cs) was found in the studied samples. In order to evaluate the radiological hazard of the natural and artificial radioactivity, average of radium equivalent activity (Ra_{eq}), gamma absorbed dose rate, the external hazard index (H_{ex}), the internal hazard index (H_{in}) and annual effective dose rate for different milk samples were found 30.44 Bqkg^{-1}, 14.29 nGyh^{-1}, 0.082 mSvy^{-1}, 0.12 mSvy^{-1} and 0.017 mSvy^{-1} respectively. The results of the radiological hazards were compared with the International standards and they were found to be within the safety levels.

*Department of Nuclear Engineering, University of Dhaka
**Nuclear Power and Energy Division, Bangladesh Atomic Energy Commission.

1.8 Monitoring of radiation level in several labs of NINMAS and INMAS, Dhaka

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

Objective: To monitor the radiation level to ensure the safety of radiation workers in several labs of NINMAS and INMAS, Dhaka

Current progress: Several spots of NINMAS and INMAS, Dhaka have been surveyed with Geiger counter (Gamma-Scout). The radiation levels were varied for different labs or rooms. In INMAS, the radiation level in hot lab (inside),waste box, PET-CT room (without patient), SPECT-CT scanner room, Reception room were found (2.6 – 4.34) µSvh^{-1}, (0.97 – 1.38) µSvh^{-1}, (0.16– 0.18) µSvh^{-1}, (0.23–0.34) µSvh^{-1} and (0.15-0.18) µSvh^{-1}, respectively whereas in NINMAS the radiation level were found (7.5-7.89) µSvh^{-1}, (56.21-58.88) µSvh^{-1}, (3.89-4.06) µSvh^{-1} with patient, (1.17-1.34) µSvh^{-1} and (0.24-0.30) µSvh^{-1}, respectively. The radiation level indicates that in some labs operators have to follow ALARA principle and have to use personal dosimeter properly for their protection.

1.9 Study on outdoor environmental gamma radiation of Ramna Thana by In-situ method

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

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

*Department of Physics, Mawlana Bhashani Science and Technology University

1.10 Study on indoor gamma radiation of INMAS Mitford hospital campus by In-situ method

M. S. Rahman, M. D. Huda*, S. Yeasmin, M. M. M. Siraz, S. Pervin, S. Banik, Z. Hossain and J. Islam*

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

Current Progress: In-Situ indoor radiation was measured at 26 locations of INMAS, Mitford Hospital Campus using real-time gamma radiation measuring device (GAMMA-SCOUT GmbH & Co. KG). This device meets all European CE standards as well as the American "FCC 15 standard". All the locations were marked out using global positioning system (GPS). The indoor radiation dose rate varied from 0.151- 4.31 µSv/h with an average of 0.456 µSv/h. The annual effective dose of the population due to the indoor gamma radiation was also calculated and it was varied from 0.305 – 8.764 mSv.

*Department of Physics, Mawlana Bhashani Science and Technology University

1.11 Study on outdoor environmental gamma radiation of Motijheel Thana by In-situ method

M. S. Rahman, M. B. Hossain*, S. Yeasmin, M. M. M. Siraz, S. Pervin, S. Banik, Z. Hossain and M. A. H. Bhuiyan*

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 27 locations of Motijheel 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 0.095-0.185 µSv/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 Environmental Sciences, Jahangirnagar University

1.12 Study on indoor radiation of INMAS Mitford hospital campus by In-situ method

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

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

Current Progress: In-Situ indoor radiation was measured at 25 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 0.181- 15.182 µSv/h with an average of 1.054 µSv/h. The annual effective dose of the population due to the indoor gamma radiation was also calculated and it was varied from 0.279 – 23.514 mSv.

*Department of Physics, Pabna University of Science and Technology

1.13 Radiation monitoring around BSMMU campus by In-situ method

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

Objective: To measure real-time radiation around BSMMU Campus from natural and artficial radionuclides.

Current Progress: In-Situ Environmental gamma-ray dose rate was measured at 32 locations around BSMMU Campus using real-time environmental radiation measuring device (GAMMA-SCOUT GmbH & Co. KG). This device meets all European CE standards as well as the American "FCC 15 standard". All the locations were marked out using global positioning system (GPS). The dose rate varied from 0.067-3.108 µSv/h with an average of 0.439 µSv/h. The annual effective dose of the population due to the radiation was also calculated and it was varied from 0.117 – 5.445 mSv.

*Department of Environmental Sciences, Jahangirnagar University

1.14 Study on outdoor environmental gamma radiation of New Market Thana by In-situ method

M. S. Rahman, I. Z. Khanom*, S. Yeasmin, M. M. M. Siraz, S. Pervin, S. Banik, Z. Hossain and 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 New Market 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 0.086-0.197 µSv/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

1.15 Study on indoor radiation of AECD campus by thermoluminescent dosimeter

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

Objective: AECD workers usually handle radioactive sources during service and R & D activities. So, there is a possibility to receive higher doses during their daily work. Therefore, it is required to measure real-time gamma radiation dose rate in AECD Campus in order to ensure safe working environment of workers.

Current Progress: Indoor radiation was measured at 20 locations of AECD Campus using thermoluminescent dosimeters. The measurement was performed from Nov 2018-April 2019. The indoor radiation dose rate varied from 352- 482 µSv/month with an average of 354 µSv/month. The annual effective dose of the population due to the indoor gamma radiation was also calculated and it was varied from 1.279 – 3.114 mSv.

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1.16 Measurement of indoor Radon levels in air using radon detector RAD7

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

Objective: It is necessary to measure radon in air because radon is responsible for lung cancer.

Current Progress: Indoor radon concentration was measured in eight locations of Atomic Energy Centre, Dhaka campus in the period of September 2018 to December 2018. The radon concentration in the studied locations ranged from 28.6±13.0 Bq/m^3 to 125±20.6 Bq/m^3 with an average value of 70.75±26.43 Bq/m^3. Conclusions: The observed indoor radon concentration values are well below the action level recommended by International Commission on Radiological Protection (200-300 Bq/m^3). According to USEPA, the safe limit of radon activity concentration is 148 Bq/m^3. From this measurement, it is observed that the radon activity concentration is within the safe limit in all places. These results will be helpful for further research on variation of radon concentration due to different factors.

1.17 Measurement of the activity concentration of natural radionuclides in soil samples and associated health hazards in Magura District, Bangladesh

M. S. Hassan*, S. Pervin, M. M. M. Siraz, M. I. Hosan*, S. Banik and S. Yeasmin

Objective: It is necessary to monitor the level of environmental radiation and radioactivity to ensure a safe and secured environment.

Current Progress: The average activity concentration value of ^{226}Ra, ^{238}U, ^{232}Th and 40K for soil of Magura is 28.21±3.46 Bq/kg, 27.76±3.49 (Bq/kg), 29.40±4.01 (Bq/kg) and 280.29±24.28 (Bq/kg) respectively. The lowest and highest absorbed dose (out) rate are 11.20709 (n Gyh-1) to 64.42763 (n Gyh-1). The average value 43.6192 (n Gyh-1) which is lower than world average value. The annual average effective dose 0.310268 (mSv/yr) of the samples from magura which is below the world average value. The highest value of annual effective dose is 0.45828 (mSv/yr) and the lowest value is 0.07971 (mSv/yr).The Radium Equivalent Activity for Magura ranges is 22.989 (Bq/kg) to 137.4434 (Bq/kg) with an average value of 110.0128 (Bq/kg) which is below the world average value. The internal hazard index for Magura ranges 0.057977 (mSv/yr) to 0.499133 (mSv/yr) with the average internal hazard index was 0.324293 (mSv/yr)**.**The external hazard index for the

study area ranges from 0.04827 (mSv/yr) to 0.37122 (mSv/yr) with the average external hazard index was found to be 0.248042 (mSv/yr).Both the external (Hex) and internal (Hin) hazard index are less than unity for all the soil samples from Magura district. No artificial radioactivity was found in the samples. The result of this studies aimed to enlarge baseline database in Magura, Bangladesh for radiological protection of people.

*Department of Nuclear Engineering, University of Dhaka

1.18 Measurement of gross alpha activity in tep and tube well water samples collected from old Dhaka by using Zinc Sulphide scintillation detector

M. F. Islam*, S. Pervin, M. M. M. Siraz, M. J. Dewan*, S. Banik and S. Yeasmin

Objective: The main objective of this study is to determine the Gross alpha radioactivity in different water sample.

Current Progress: The gross alpha activity was measured in tap and tube well water samples collected from different locations of Old Dhaka, especially Sutrapur Thana, Dhaka Division by using Zinc Sulphide Scintillation Detector, ZnS(Ag). Screening was carried out for collected fifteen samples; of which ten were tap water and the rest of five were tube well water. The gross alpha activity of the fifteen water samples ranged from 0.8 mBq/L to 14.46 mBq/L. The average gross alpha concentration was found to be 5.09 mBq/L. This was well below the permissible limit of 0.1 Bq/L or 100 mBq/L recommended by World Health Organization (WHO).

*Department of Nuclear Engineering, University of Dhaka

1.19 Study of gross alpha activity in tap water samples in Dhaka city

S. Yeasmin, J. Ferdous, M. M. M. Siraz, S. Banik and S. Pervin

Objective: When alpha-emitting radioisotopes are ingested to the body, they are twenty times more effective in damaging cells in comparison to gamma rays and X-rays and lead to the doses for internal radiation. Due to the presence of such kind of radionuclides in drinking water (tap water), at present it is the vital research issue in globally to ensure the safe level of radioactivity in drinking water. The activity of gross alpha for thirteen tap water samples collected from different residential areas of Dhaka city are being analyzed using Zinc Sulphide scintillation detector Zn(Ag)S. The main objective of this study is to analyze the gross alpha activity in drinking water (tap water) and to compare with World Health Organization (WHO) recommended value.

Current Progress: The gross alpha activity concentration in thirteen tap water samples has been measured from different residential areas of Dhaka city using Zinc Sulphide scintillation detector Zn(Ag)S. From this study, the result showed that the activity of gross alpha in the tap water samples were from 0.00045 Bq/L to 0.01359 Bq/L which is below the guideline level 0.1 Bq/L in drinking water recommended by World Health Organization (WHO) [Guidelines for Drinking-water Quality, 2006]. So the tap water of this study is safe from the standpoint of gross alpha activity. The gross alpha activity measurement is a screening technique for monitoring tap water and no information on specific radionuclide can be obtained. This kind of study can be helpful to create a baseline data for gross alpha activity and also for further analysis in identifying specific radionuclide

1.20 Measurements of the natural radioactivity in building materials (cement) taken from different manufactures in Dhaka city

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

Objectives: The average dose received by the population is mainly comes from the natural radionuclides. Natural radionuclides in building material are the sources of external and internal radiation exposure in dwellings.

Current Progress: In this study the activity concentrations of ^{226}Ra, ^{232}Th and ^{40}K in different cement samples were measured by Gamma-ray spectroscopy system using High purity Germanium (HPGe) detector with 20% relative efficiency. A total of thirteen cement samples were collected from different manufactures of Dhaka city. The average activity concentrations of ^{226}Ra, ^{232}Th and ^{40}K in cements samples was found 32.20±15.04 Bqkg^{-1}, 18.26±11.76Bqkg^{-1} and 57.89±24.14Bqkg^{-1} respectively. The calculated average value is lower than the world average limit. The average value of radium equivalent activity for cements was found 65.67 Bqkg^{-1} which is less than the world average value 370 Bqkg^{-1}. Internal hazard index & External hazard

index were found to be varied from 0.26 and 0.18 respectively; these values are less than unity in all samples that indicate the non-hazardous nature of the samples. Absorbed dose rate were found to be varied from 8.54nGyh^{-1} to 41.82nGyh^{-1} with an average value 26.09nGyh^{-1}. Annual effective dose rate were found to be varied from 0.04mSvy^{-1} to 0.20mSvy^{-1} with an average value 0.13mSvy^{-1} which is below the recommended level of 1mSvy^{-1}.

*Department of Nuclear Engineering, University of Dhaka

1.21 Environmental gamma radiation dose rate measurement in Dhaka city using a digital portable gamma-scout detector

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

Objectives: The aim of this study was to detect the presence of natural and artificial radionuclides (if any) releasing from nuclear facilities in the country or from neighboring countries.

Current Progress: The measurement was performed using a digital portable Gamma-Scout detector. Total fifteen monitoring points were selected for collection of gamma-ray dose rate in the outdoor environment of different location of Dhaka city. The measurements were performed during from January to September 2017. All the Monitoring Points were marked-out using Global Positioning System (GPS). The measured dose rates due to natural radionuclides were ranged from 0.13±0.00791 μSv/hr to 0.23±0.0141μSv/hr with an average of 0.157±0.01353 μSv/hr. The annual effective dose to the population from outdoor environmental gamma radiation was varied from 0.15943±0.00970 mSv/y to 0.28207±0.01729 mSv/y with average value 0.19254±0.01660 mSv/y.

1.22 Assessment of activity concentration in medicinal plants of Bangladesh

S. Sultana*, J. Ferdous, S. Yeasmin, M. M. M. Siraz, S. Pervin, S. Banik, Z. Hossain and Dr. M. M. Haque*

Objective: To investigate gamma emitting natural radionuclides in medicinal plant samples frequently used in Bangladesh.

Current Progress: A total of 39 different medicinal plant samples were collected from local market and the gamma spectrometry was carried out using HPGe detector coupled with a computer-based high-resolution multi-channel analyzer. the activity concentrations in the medicinal plants ranges from 4.12 to 28.22 Bq.kg^{-1}, 3.02 to 17.62 Bq.kg^{-1} and 363 to 1097 Bq.kg^{-1} for 238U, 232Th, and ^{40}K with the mean value of 12.65±5.20, 7.38±3.45, and 661.12±202.56 Bq.kg^{-1}, respectively. This results revealed that the overall activity concentration of 238U is significantly higher than those of 232Th in the medicinal plants. No 137Cs is found in the samples of the present study, which indicates that there is no nuclear fallout in the places under study.

*Department of Physics, University of Rajshahi.

1.23 Accidental and retrospective dosimetry using environmental materials by TL method

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

Objective: After an unexpected event retrospective/accident dosimetry techniques are considered as important tools in the management of radiological emergency, and can provide timely assessments of exposures to the mass causalities. In the affected area several objects can be considered as natural dosimeters; some of these materials are suitable for retrospective dosimetry using thermoluminescence (TL) analysis.

Current progress: Samples of some environmental materials, viz. mobile-phone screen and optical fiber, were studied by investigating key TL properties, including TL dose response, glow curves, reproducibility and long-term stability of the TL signal. Within the gamma radiation dose range up to 10 Gy, these parameters show for both the mobile phone screen and optical fiber to offer as suitable materials for retrospective dosimetry. Reconstruction of absorbed dose is possible for a period of up to six weeks post-incident (post irradiation). The results of the measurement were also compared with the most commonly used reference dosimeter TLD-100 chips containing LiF doped with Mg and Ti. The results of this study represent promising indication of the use of both smart phone screen and silica based glass optical fiber samples as accident dosimetry.

1.24 Comparison of thermoluminescence characteristics of two different type TLDs in radiation dosimetry

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

Objective: The purpose of this work is to compare the response obtained with the TLD chips of TLD 100 and TLD 700 with β-γ irradiation.

Current progress: The TLD 100 and TLD 700, due to presence of difference in the concentration of isotopes of Li, are abundantly used to obtain the information of radiation dose such as gamma and beta. Response of TLD-100 and TLD-700 under varying dose from 1.4 to 7.0 mGy was compared. In this work thirty TLDs of two different types was used: TLD 100 and TLD 700. The TLDs were irradiated in an experimental setup using a Sr-90/Y-90 irradiator. The composition of the dose in different types of TLDs was evaluated for dosimetric properties focusing on linearity and reproducibility. It was found that the response of TLD 700 is 1.2 times greater than that of TLD 100 and the reproducibility tests made on two types of chips were found satisfactory.

1.25 Thermoluminescence responses of TLD – 100 subjected to low dose irradiation

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

Objective: The increasing use of radiation especially low density radiation in everyday life demands an evaluation of the performance of dosimeter in respective environment. The present work is concerned with the investigation of thermoluminesence response of TLD-100 in low radiation dose environment.

Current progress: Ten Harshaw TLD cards were irradiated at different low dose radiation namely 46.8 µGy, 93.82 µGy, 140.73 µGy, 187.64 µGy and 234.1 µGy with Sr90/Y90 Irradiator and read in Harshaw 4500 TLD Manual Reader. Following the reading, detection limit, linearity, and repeatability, variation of standard deviation and coefficient of variation were investigated. After that the same TLDs were irradiated at dose of 140.73 µGy and fading test was incorporated for 7 days. TLD-100 upon low dose irradiation showed good linear response (Coefficient of Determination,R^2~1)as well as lower detection limit (D_L). The value of D_L has been found 40 µGy Standard deviation and coefficient of variation form decreasing pattern with increasing low density radiation. For a very short time period like7 days, TLDs showed irregular response. These investigations help to conclude that TLD-100 can be used for low dose environment with proper calibration and correction factor calculation.

*Department of Nuclear Engineering, University of Dhaka

1.26 Study of TLD-100's repeatability in low dose irradiation

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

Objective: The present individual radiation monitoring system is trying to make monitoring devices more accurate and precise. The study is concerned about the repeatability of Thermo Luminescence Dosimeter-100 (TLD-100) at low dose irradiation.

Current Progress: In this study ten LiF: Mg, Ti, commercially known as TLD-100, were irradiated in BICRON Sr90/Y90 Irradiator Model 2210 with five different doses. Most important property of TLD-100s which is linearity has proved right even in very low dose irradiation. So in terms of verification of certain and vital characteristics, TLD-100s applicability has been proved justified for low dose detection. It's usage as individual monitoring is expected to be valid. For more reliability other properties of TLD-100 must be studied like energy dependence, angular dependence etc.

*Department of Nuclear Engineering, University of Dhaka

2. 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 (NORM) samples of different gas fields
- Measurement of environmental gamma doses by In-Situ method
- Assessment of Gross Alpha and Gross Beta activity in environmental samples
- Determination of the Radon concentration in environmental samples such as air, water and soil

3. 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

4. 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

5. Quality Assurance Programme for Radioactivity Measurement

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

6. Quality Assurance Programme of Individual Monitoring System

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

7. Seminar/Symposium/Conference/Workshop Attended

Name of the participant	Title of the event	Organizer	Date	Place
S. Yeasmin	1st National Conference on Energy Technology and Industrial Automation (NCETIA-2018)	Institute of Energy Technology, CUET	13 Dec. 2018	CUET
	International Conference on Electronics and ICT-2018	Bangladesh Electronics Society and BAEC	25-26 Nov. 2018	AECD, Dhaka
	National Conference on Physics-2019	Bangladesh Physical Society	07-09 Feb. 2019	Dhaka University
	7th International Conference on Water and Flood management	Institute of Water and Flood management, BUET	02-04 Mar. 2019	CIRDAP Auditorium, Dhaka
Dr. M. S. Rahman	International Conference on Electronics and ICT-2018	Bangladesh Electronics Society and BAEC	25-26 Nov. 2018	AECD, Dhaka
	National Conference on Physics-2019	Bangladesh Physical Society	07-09 Feb. 2019	Dhaka University
	7th International Conference on Water and Flood management	Institute of Water and Flood management, BUET	02-04 Mar. 2019	CIRDAP Auditorium, Dhaka
J. Ferdous	International Conference on Electronics and ICT-2018	Bangladesh Electronics Society and BAEC	25-26 Nov. 2018	AECD, Dhaka

Name of the participant	Title of the event	Organizer	Date	Place
	National Conference on Physics-2019	Bangladesh Physical Society	07-09 Feb. 2019	Dhaka University
Dr. A. K. M. M. Rahman	International Conference on Electronics and ICT-2018	Bangladesh Electronics Society and BAEC	25-26 Nov. 2018	AECD, Dhaka
	National Conference on Physics-2019	Bangladesh Physical Society	07-09 Feb. 2019	Dhaka University
M. M. M. Siraz	Basic Radiation Knowledge for School Education Course	Japan Atomic Energy Agency	05-16 Nov. 2018	Tokaimura, Japan,
	1st National Conference on Energy Technology and Industrial Automation (NCETIA-2018)	Institute of Energy Technology, CUET	13 Dec. 2018	Institute of Energy Technology, CUET
	International Conference on Electronics and ICT-2018	Bangladesh Electronics Society and BAEC	25-26 Nov. 2018	AECD, Dhaka
	National Conference on Physics-2019	Bangladesh Physical Society	07-09 Feb. 2019	Dhaka University
	7th International Conference on Water and Flood management	Institute of Water and Flood management, BUET	02-04 March 2019	CIRDAP Auditorium, Dhaka
S. Pervin	Regional Training on Internal Dose Assessment and Bioassay Methods in Assessing Occupational Intakes of Radionuclides (RAS9080)	IAEA	05-16 Nov. 2018	Seoul, Korea
	1st National Conference on Energy Technology and Industrial Automation (NCETIA-2018)	Institute of Energy Technology, CUET	13 Dec. 2018	Institute of Energy Technology, CUET
	International Conference on Electronics and ICT-2018	Bangladesh Electronics Society and BAEC	25-26 Nov. 2018	AECD, Dhaka
	National Conference on Physics-2019	Bangladesh Physical Society	07-09 Feb. 2019	Dhaka University
	7th International Conference on Water and Flood management	Institute of Water and Flood management, BUET	02-04 Mar. 2019	CIRDAP Auditorium, Dhaka
N. Hassan	Training Course on Environmental monitoring and Mapping.	IAEA	06-10 May, 2019	Pecs, Hungary
	International Conference on Electronics and ICT-2018	Bangladesh Electronics Society and BAEC	25-26 Nov. 2018	AECD, Dhaka
	National Conference on Physics-2019	Bangladesh Physical Society	07-09 Feb. 2019	Dhaka University
S. Banik	International Conference on Electronics and ICT-2018	Bangladesh Electronics Society and Bangladesh Atomic Energy Commission	25-26 Nov. 2018	Atomic Energy Centre, Dhaka
	Nuclear and Radiological Emergency Preparedness Course at BAEC-2018	BAEC and JAEA	25 Nov. 06 Dec. 2018	TI, AERE

Name of the participant	Title of the event	Organizer	Date	Place
	1st National Conference on Energy Technology and Industrial Automation (NCETIA-2018)	Institute of Energy Technology, CUET	13 Dec. 2018	Institute of Energy Technology, CUET
	7th International Conference on Water and Flood management	Institute of Water and Flood management, BUET	02-04 Mar. 2019	CIRDAP Auditorium, Dhaka
	National Conference on Physics-2019	Bangladesh Physical Society	07-09 Feb. 2019	Dhaka University

8. Training Course Organized and Seminar Arranged

Title of the event	Date	Place	No. of participant
7th Follow-up Training Course entitled "Environmental Radioactivity Monitoring Course at BAEC (ERMCB-7) 2018"	13-17 Jan. 2019	TI, AERE	23
7th Follow-up Training Course entitled "Nuclear and Radiological Emergency Preparedness Course at BAEC (NREPCB-7)"	25 Nov. -06 Dec. 2018	TI, AERE	21

9. Collaboration Work

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

Collaboration Project with IAEA

- IAEA/TC project BGD/9/015- Strengthening National Capacity build-up for the protection of workers Exposed to ionizing Radiation and public
- RAS/9/080- Enhancing National Capabilities on Occupational Radiation Protection in Compliance with Requirements of the New International Basic Safety Standards
- IAEA Co-ordinated Research Project: "In-Situ Measurements for Rapid Environmental Mapping of Contaminated Sites" (IAEA Research Contract No. 18197)

To enhance knowledge on radiological science the senior scientists of HPD have been delivering theoretical lectures, preparing and editing question papers in the field of Medical Physics, Health physics & Radiation Protection in the following areas:

- M. Phil in Nuclear Medicine, Part-I students of Bangabandhu Sheikh Mujib Medical University
- A sessional course of level-2, term-1, Department of Nuclear Science and Engineering, Military Institute of Science and Technology (MIST)
- Question preparation, moderation of the question setting and evaluation of the Exam paper on Basic Physics part-I, paper-III of M. Phil (Nuclear Medicine) examination

10. Services Rendered

10.1 Radioactivity Testing of Imported and Exportable Food Items

Name of the month	Milk & milk products (A)	Others (B)	Imported C = A+B	Domestic product	Individual product	Monthly total
July'18	113	82	195	2	17	214
Aug'18	65	33	98		43	142

Name of the month	Milk & milk products (A)	Others (B)	Imported C = A+B	Domestic product	Individual product	Monthly total
Sep'18	118	80	198	1	18	217
Oct'18	127	116	243		21	264
Nov'18	128	88	216		23	239
Dec'18	175	68	243		11	254
Jan'19	174	162	336		15	351
Feb'19	189	52	241		5	246
Mar'19	194	98	292	1		293
April'19	136	35	171	5	19	195
May,19	133	68	201		5	202
June'19	93	18	111	1	6	118
Grand Total						**2735**

10.2 Gross Alpha and Gross Beta Measurement

Name of the organization provided to services	Type of sample	No. of sample	Total parameter
Square Pharmaceuticals Ltd. (Dhaka unit)	Bore Hole water	4	4
Beximco Pharmaceuticals Ltd. (Dhaka unit)	Portable water	2	2
SK-F Pharmaceuticals Ltd.(BD)	Portable water	1	1
Mohd Nur-E-Siddique, Uttara, Dhaka	Water	3	3

10.3 TLD Badges Issue

Name of the month	No. of new organizations	No. of new workers
July'2018	16	45
August'2018	24	91
September'2018	43	53
October'2018	30	64
November'2018	28	56
December'2018	25	31
January'2019	19	68
February'2019	20	35
March'2019	31	52
April'2019	37	80
May'2019	18	30
June'2019	14	34
Total	**305**	**639**

10.4 Dose Measurement and Reporting

Name of the month	No. of organizations	No. of measured TLD badges
July'2018	400	1034
August'2018	266	811
September'2018	357	948
October'2018	354	1261

Name of the month	No. of organizations	No. of measured TLD badges
November'2018	317	941
December'2018	332	950
January'2019	438	1359
February'2019	278	928
March'2019	374	826
April'2019	368	984
May'2019	376	1368
June'2019	195	557
Total	4055	11967

10.5 Individual Radiation Monitoring

Practices	No. of organizations	No. of radiation workers
Radiotherapy	13	329
Nuclear Medicine	18	475
Industrial Radiography	37	251
Diagnostic Radiology	4112	7356
Research	17	370
Others (Quality Control, Level Gauge etc)	116	540
Total	4313	9321

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, "Capacity builds up of Nano and Nano and biomedical laboratories in MSD, AERE". 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 / dielectric materials
- Development of ferrite permanent magnets from beach sand mineral magnetite extracted from Cox's bazar beach sand
- Study of the magnetic and structural properties of amorphous/ nanocrystalline materials
- Study of the structural and magnetic properties of perovskites

- Crystallographic characterization and quantitative phase study of inorganic, organic, thin film and unknown materials by XRD method
- In-situ high temperature phase transition study of binary alloys
- Study of the magnetic and electrical properties of microwave ferrite materials.
- Mineralogical study of soil, rock, clay, terracotta and silt materials by XRD method
- Synthesis and Characterization of Chitosan, ZrO_2, Al_2O, etc ceramic materials for biomedical application
- Preparation of functionalized Carbone nanotube Applications
- Synthesis of Graphine Oxide and Reducel and its appilicationd Graphoine Oxide

Activities

1. Research and Development Work(s)

1.1 Synthesis of hydroxyapatite by wet chemical precipitation method and characterization of hydroxyapatite-chitosan-gelatin based bone scaffold for biomedical application

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

Objective: The objective of the work is to Synthesis of Hydroxyapatite by Wet Chemical Precipitation Method and Characterization of Hydroxyapatite-Chitosan-Gelatin Based Bone Scaffold for Biomedical Application

Current progress: Phase pure hydroxypatite (HAp) have beensynthesized by wet chemical precipitation method using calcium nitrate tetrahydrate [$Ca(NO_3)_2.4H_2O$] and diammonium hydrogen phosphate [$(NH_4)_2HPO_4$]. Composite networks have been prepared through freeze drying technique with the cross-linking agent of biopolymer glutaraldehyde. Energy Dispersive X-ray Spectroscopy (EDXS) confirms the Scaning Electron Microscopy (FESEM) reveals the formation of a well interconnected porous scaffold with a pore size in the range of 30- 250µmwhich is good for tissue ingrowth and also executing osteoinduction and osteointegration. Raman Spectroscopy of prepared scaffold is mostly similar to human bone. The mechanical strength of prepared scaffold is within the range of that exhibited by cancellous bone. The cytotoxicity measurement have been done by VERO cells which uncovered that the prepared sample are non-toxic.

*Department of Physics, University of Dhaka

1.2 Synthesis of Iron-Oxide (α-Fe_2O_3) nanoparticle by hydrothermal process and study the viability of chitosan coated particle in hyperthermia for cancer

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

Objective: The objective of the work is to Synthesis of Iron-Oxide (α-Fe_2O_3) Nanoparticle by Hydrothermal Process and Study the Viability of Chitosan Coated Particle in Hyperthermia for Cancer

Current progress: In this work, α-Fe_2O_3nanoparticles were synthesized via a facile hydrothermal method and then coated with chitosan to make it target specific for malignant cells. The XRD pattern showed that the iron oxide nanoparticles exhibited α-Fe_2O_3 (hematite) structure in nanocrystals. VSM study showed ferromagnetic nature with a particle superparamagnetic behavior of the synthesized nanoparticles. The formation of both ferromagnetic and superparamagnetic nature. Dynamic light Scattering technique (DLS) data showed that the hydrodynamic diameter of the coated particles was between 218.3 nm to 235.3 nm with a PDI range of 0.048 to 0.119. This was clear indication that this coated particle can be applied for biomedical purposes. The value of the zeta potential was +46.8mV which confirmed that the nanoparticles had good stability. Cytotoxicity of the coated sample was examined and confirmed non-toxic behavior. Hyperthermia study indicated that at concentration of 2 mg/ml, 46.5°C temperature was obtained which is sufficient for cancer cell destruction. From the high temperature response and nontoxic results, it can be conclude that this synthesized nanoparticles cn be effectively used to damage cancer cell through hyperthermia.

*Department of Physics, University of Dhaka

1.3 Synthesis of hydroxyapatite particle by hydrothermal method and a study of pysichemical properties of hydroxyapatite-gelatin-chitosan composite scaffolds for bone tissue engineering

S. M. Hoque, S. I. Liba, A. Nahar, A. A. Begum, K. Hasan, N. Begum and T. A. Sushmi*

Objective: The objective of the work is to Synthesis of Hydroxyapatite Particle by Hydrothermal Method and a Study of Pysichemical Properties of Hydroxyapatite-Gelatin-Chitosan Composite Scaffolds for Bone Tissue Engineering.

Current progress: Bone tissue engineering has been heralded as the alternative strategy to regenerate bone. The biomimetic approach has been used in this field for a long time. Much attention has been paid to hydroxyapatie because of its chemical and crystallographic similarities to the inorganic component found in natural bone. Its outstanding properties like biocompatibility, bioactivity, osteoconductivity, non-toxicity made it more suitable for bone tissue engineering. In this work hydroxyapatite (HAP) particle was synthesized by hydrothermal method using calcium nitrate tetra-hydrate ($Ca(NO_3)_2.4H_2O$) and di-ammonium hydrogen phosphate ($(NH_4)_2HPO_4$) as precursors. The structural and morphological properties were studied by XRD, TEM, EDS. EDS showed that the Ca/P ratio on the prepared HAP was 1.57. The presence of functional group (PO_4^{3-}) and OH- of HAP along with OH- group from absorbed H_2O and CO_3^{2-} were found with the help of FTIR and Raman spectroscopy. Then, a number of bone scaffolds were fabricated with varying composition hydroxyapatite, chitosan and gelatin using freeze drying method where glutaraldehyde solution has been used into the scaffolds to cross-link the amino groups (─NH_2) and the aldehyde groups (─CHO) of chitosan and gelatin. XRD of the composites showed higher intensity of HAP peaks with the increase of HAP amount in the composite. Scanning electron microscope confirmed the development of a porous scaffold as desired. The initial pores size was about 200-400 which decreased less than 150nm as the wt% of HAP increased in the scaffolds. Characteristic IR band for (–C=N–) group observed in FTIR study of the prepared scaffold indicated the crosslinking ability of Glutaraldehyde with chitosan and gelatin and the study also confirmed the presence of hydroxyl group (OH-), phosphate group (PO_4^{3-}), carbonate group(CO_3^{2-}). Several moulds were formed using silica sealant and cornstarch to create scaffolds with specific shapes and it was found that the formed mould was able to capture fine details of human Phalanges bone. Both the scaffolds developed with and without the mould was examined qualitatively by VERO cell for cytotoxicity and both the samples were found to be non-toxic. Thermo-gravimetric analysis (TGA) of the samples showed that the scaffold will be perfectly stable until 500°C.

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1.4 Synthesis of nano-sized Magnesium Ferrite ($MgFe_2O_4$) using chemical co-precipation method and coated with chitosan for viability of hyperthermia for cancer treatment

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

Objective: The objective of the work is to Synthesis of Nano-Sized Magnesium Ferrite ($MgFe_2O_4$) Using Chemical Co-precipation Method and Coated with Chitosan for Viability of Hyperthermia for Cancer Treatment.

Current progress: The activation of magnetic nanoparticles (MNPs) by an alternating magnetic field (AMF) is currently being explored as a technique for targeted therapeutic heating of cancer cells. Recently, magnesium ferrite nanoparticles have attracted much consideration as a therapeutic agent due to their unique properties. In this work, $MgFe_2O_4$ nanoparticles were synthesized by chemical co-precipitation method and then coated with chitosan to make it target specific for malignant cells. The X-ray diffraction (XRD) patterns confirmed that the prepared sample was pure $MgFe_2O_4$ and XRD results also indicated the presence of single phase mixed spinel structure of $MgFe_2O_4$. From the Scherer's formula it was found that the grain size is 10.42 nm and the lattice parameter was calculated from Nelson-Riley formula which was 8.31 Å. VSM study showed ferromagnetic nature at 5K temperature and superparamagnetic behavior at 300K temperature of the synthesized nanoparticles. The formation of the sextets and doublet in Mössbauer spectra analysis was also an indication of both ferromagnetic and superparamagnetic nature. Fourier transform infrared (FTIR) analysis confirmed that the sample is well coated with chitosan. Raman spectroscopy indicates five active modes which were A1g, Eg and 3F2g. That was the confirmation of mixed spinel type cubic structure of $MgFe_2O_4$ belonging to the space group Fd-3m. Dynamic light scattering technique (DLS) data showed that the

hydrodynamic diameter of the coated particles was between 229.2 nm to 168.6 nm with a PDI range of 0.214 to 0.268. The range of hydrodynamic diameter for biomedical application is less than 250 nm with a PDI value less than 0.35. So that was a clear indication that this coated particle can be applied for biomedical purposes. The value of the zeta potential was +46.9 mV which confirmed that the nanoparticles had good stability. Cytotoxicity of the coated sample was examined by applying the sample into Vero cell line, a kidney epithelial cell extracted from an African green monkey and confirmed non-toxic behavior with survival of cells reported greater than 95%. Lastly hyperthermia study indicated that at concentration of 2 mg/ml, 46.1°C temperature was obtained which is sufficient for cancer cell destruction. From the high temperature response and nontoxic results, it can be concluded that this synthesized nanoparticles can be effectively used to damage cancer cell through hyperthermia.

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1.5 Preparation of Zinc substituted Cobalt Ferrite nanoparticles by Sol-Gel process and coated with Dextran for MRI contrast of brain and cancer treatment by hyperthermia

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

Objective: The objective of the work is to Preparation of Zinc Substituted Cobalt Ferrite Nanoparticles by Sol-Gel Process and coated with Dextran for MRI Contrast of Brain and Cancer Treatment by Hyperthermia.

Current progress: In this study, zinc substituted cobalt ferrite ($Zn_{.6}Co_{.4}Fe_2O_4$) nanoparticles were prepared by Sol-Gel method and were coated with dextran. The particle size obtained by X-ray diffraction (XRD) analysis and the size obtained was 29.52 nm with lattice parameter 8.32 Å. XRD also confirmed that only single phase was formed. FTIR and RAMAN spectroscopy provided the information about presence of the respective component in the structure of the nanoparticle. From transmission electron microscopy (TEM) analysis, the average particle size of uncoated sample obtained was 25.6 nm and the size of the coated particle was below 10 nm. The particle also showed superparamagnetic properties with saturation magnetizationm43.52 emu/g at room temperature. Super paramagnetic properties was confirmed by Mössbauer analysis. Dynamic light scattering (DLS) was used to determine hydrodynamic diameter and polydispersity index (PDI) of the coated particle which was 295 nm and 0.356 respectively. Zeta potential is also obtained which was 2.41 mV. Cytotoxicity test proved that the particles were non toxic. Hyperthermia measurement showed that the temperature above 42ºC is easily obtained and the particle is suitable for thermo-therapeutic application of cancer treatment. The MRI result was also satisfactory which was carried on a female rat.

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1.6 Synthesis of hydroxyapatite by wet chemical precipitation method and development of hydroxyapatite-chitosan-gelatin based bone scaffold for bone tissue engineering

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

Objective: The objective of the work is to Synthesis of Hydroxyapatite by Wet Chemical Precipitation Method and Development of Hydroxyapatite-Chitosan-Gelatin Based Bone Scaffold for Bone Tissue Engineering

Current progress: Hydroxyapatite powder was prepared by wet precipitation method using calcium nitrate tetrahydrate ($Ca(NO_3)_2.4H_2O$) and di-ammonium hydrogen phosphate ($(NH_4)_2HPO_4$) as precursors. The porous composite scaffolds were fabricated with varying ratio of synthesized hydroxyapatite (HAp), chitosan and gelatin using freeze-drying method. Fourier Transformation Infrared Spectroscopy (FTIR) The size of the HAp particles was measured by transmission electron microscope (TEM). Microstructural investigation of scaffold by Field Emission Scanning Electron Microscopy (FESEM) reveals the formation of a well interconnected porous scaffold with a pore size in the range of 50−300μm which is good for tissue ingrowth and also executing osteoinduction and osteointegration. Energy Dispersive X-ray Spectroscopy (EDX) confirms the stoichiometric ratio of Ca/P is 1.58 of prepared HAp. Thermal stability of the scaffold has been observed by Thermo-Gravimetric Analysis (TGA). The cytotoxicity measurement has been done by VERO cells which uncovered that the prepared scaffold is non-toxic.

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1.7 Synthesis of Nickel Ferrite ($NiFe_2O_4$) nanoparticle by sol-gel auto combustion method and study the magnetocaloric effect (MCE) for using it as magnetocaloric material (MCM) in magnetic refrigeration

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

Objective: The objective of the work is to Synthesis of Nickel Ferrite ($NiFe_2O_4$) Nanoparticle by Sol-gel auto combustion method and study the Magnetocaloric effect (MCE) for using it as Magnetocaloric material (MCM) in Magnetic Refrigeration.

Current progress:

The nanoparticles were synthesized using sol-gel auto combustion method. Extensive characterization of structural & magnetic properties was done using XRD, FTIR, TG analysis.

In our studies, we observed maximum change of entropy 0.482 $Jkg^{-1}k^{-1}$,0.579 $Jkg^{-1}k^{-1}$,0.719$Jkg^{-1}k^{-1}$,0.782$Jkg^{-1}k^{-1}$ corresponding to the magnetic field of values IT, 2T, 3T, 4T, 5T which occurs at 740 K. This results in a larger entropy change in comparision with the MCE (magnetic caloric effect) results on other reported ferrite nanoparticles.

Moreover one of basic hurdle is to find materials with wide operating temperature span. In this regard a new approach, where instead of a single material a combination of nanostructure materials in a matrix, is being proposed. Each material in the matrix has its Tc at different points on the desired temperature scale thus giving a wide range of operating temperature span.

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1.8 Synthesis of magnesium ferrite ($MgFe_2O_4$) nanoparticle by sol-gel auto-combustion process and study of magneto caloric effect (MCE) as a magnetic materials for magnetic refrigeration and heating

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

Objective: The objective of the work is to Synthesis of Magnesium Ferrite ($MgFe_2O_4$) Nanoparticle by Sol-Gel Auto-Combustion Process and Study of Magneto Caloric Effect (MCE) as a Magnetic Materials for Magnetic Refrigeration and Heating

Current progress: Spinel-type Magnesium ferrite ($MgFe_2O_4$) nano-particles are synthesized through Sol-gel auto-combustion method and studied the Magneto Caloric Effect (MCE) which is characterized by a magnetic entropy change under a magnetic field. The XRD pattern of $MgFe_2O_4$ showed single phase structure. From the Temperature dependent magnetization measurement and M-H curve showed ferromagnetic nature of the synthesized nano particles. The formation of sextets in Mössbauer spectra analysis was also an indication of ferromagnetic nature. Fourier Transform Infrared (FTIR) analysis confirmed the nature of bonding of the sample. The magnetic entropy change calculated from the set of isothermal magnetization curves and showed the maximum entropy change of -0.52$JKg^{-1}K^{-1}$ at 716K and Relative cooing Power (RPC) OF 125JKg^{-1} for the field of 4 Tesla. Lastly in the search of new spinel ferrite materials for magneto caloric applications, $MgFe_2O_4$ has been studied and its potential for MCE is examined in this thesis.

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1.9 Study of the microstructural and magnetic properties of the spinel ferrite nanoensembles and their biomedical applications

S. M. Hoque, F. M. Kamal, M. M. Haque, M. N. I. Khan, M. A. Mamun, H. N. Das, R. Rashid, S. I. Liba, M. R. Hasan, A. Nahar, A. Kumar, A. Parveen, A. A. Begum and M. K. Islam*

Objective: The objective of the work is to Study of the microstructural and magnetic properties of the spinel ferrite nanoensembles and their biomedical applications

Current progress: We reported here, the pH dependence manganese ferrite ($MnFe_2O_4$) nanoparticles were synthesized using chemical co-precipitation method and characterized by XRD, TEM, EDX and VSM. The crystalline sizes and lattice parameters from XRD results are 5nm to 15 nm and 8.43Å to 8.50Å where EDX results are suitable for all samples. The maximum magnetizations are 8 emu/gm to 18 emu/gm during applied field 2 Tesla. The Mossbauer results confirmed the doublet pattern and superparamagnetic in nature of these

samples. The FTIR study obtained as the octahedral and tetrahedral position of all samples and confirmed the suitability of coating condition as compared to the previous standard data.

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1.10 Effect of Ti^{4+} doping on structural, electrical and magnetic properties of $Ni_{0.4}Cu_{0.2}Zn_{0.4}Fe_{2-x}Ti_xO_4$ ferrites

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

Objective: The objective of the work is to Effect of Ti^{4+} Doping on Structural, Electrical and Magnetic Properties of $Ni_{0.4}Cu_{0.2}Zn_{0.4}Fe_{2-x}Ti_xO_4$ Ferrites.

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

Chemical compositions are prepared using conventional solid state reaction method. In this study Ti is substitutions are prepared using conventional solid state reaction method. Ti is substituted for Fe at the B-site of the lattice. 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 X-ray density is found to be higher than bulk density. 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 saturation magnetization is found to be in good agreement with reported values.

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1.11 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. A. Begum, K. Hasan, A. Hossain, Z. Begum, N. Begum and A. T. Trina*

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

Current progress: Spinal type polycrystalline $Ni_{0.6}Zn_{0.4}Sr_xFe_2O_4$ (x=0.0, 0.05, 0.10, 0.15 and 0.20) ferrites are synthesized by solid state reaction method. All the samples are sintered at 1250°C for 3 hours by using Muffle furnace. 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. All the samples exhibited lower coercivity values indicating that the materials belong to the class of soft ferrites. The dielectric constant decreases with increasing frequency exhibiting normal dielectric behavior of ferrites.

* Department of Physics, University of Cumilla

1.12 Synthesis and investigation of magnetic and transport properties of Cr^{3+} substituted Mn-Ni-Zn ferrites

M. N. I. Khan, S. M. Hoque, F. M. Kamal, R. Rashid, M. R. Hasan, S. I. Liba, A. Parveen, A. A. Begum, Z. Begum, K. Islam, N. Nahar and S. Haque*

Objective: The objective of the work is to the Study of the Synthesis & Investigation of Magnetic and Transport Properties of Cr^{3+} Substituted Mn-Ni-Zn Ferrites.

Current progress: A series of Cr^{3+} substituted Mn-Ni-Zn ferrites; $Mn_{0.5}Ni_{0.1}Zn_{0.4}Fe_{2-x}Cr_xO_4$ (x=0.0-0.4 in a step of 0.1) were prepared by conventional solid state reaction method. Pellet and Toroid shaped samples were prepared from each composition and sintered at 1100°C for 3 hours in air. The microstructural analysis was done by Scanning Electron Microscope (SEM) and observed that the average grain size increases with Cr^{3+} content up to x= 0.2 and then decreases. XRD indicated single-phase cubic ferrite structure. The lattice constants gradually decreased with increasing chromium content up to x=0.2, which was attributed to the

smaller ionic radii of Cr^{3+} substituent. The increase in the lattice constants for higher concentration of Cr^{3+} can be explained as; the Cr^{3+} resides at the grain boundary thereby hindering the grain growth and exerts a pressure on the unit cell. The dielectric constant significantly with the Cr^{3+} substitution and showed the maximum value for x=0.4. The ac resistivity significantly changed with the increasing of Cr^{3+} content. The saturation magnetization, remanent magnetization and coercivity were calculated from the (M-H) hysteresis loop at room temperature. The values of saturation magnetization decreased with Cr^{3+} content.

*Dept of Physics, Faculty of Science, Comilla University

1.13 Synthesis and investigation of structural, dielectric and magnetic properties of $Co_{0.5}Zn_{0.5}Fe_{2-x}Cr_xO_4$ compounds

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

Objective: The objective of the work is to the Study of the Synthesis and Investigation of Structural, Dielectric and Magnetic Properties of $Co_{0.5}Zn_{0.5}Fe_{2-x}Cr_xO_4$ Compounds.

Current progress: Cr substituted Co-Zn ferrites having the chemical formula $Co_{0.5}Zn_{0.5}Fe_{2-x}Cr_xO_4$ (x=0.0, 0.1, 0.2, 0.3 and 0.4) have been synthesized using the solid-state reaction method. XRD patterns indicated the formation of single-phased cubic spinel structure. The SEM images exhibit that the average grain size reduces up to x-0.2 and then increases with higher substitution of Cr. From M-H graph it is clear that the increase of Cr concentration decreses the magnetization and coercivity from x=0.0-0.3 due to the lower magnetic moment of Cr^{3+} ion and the material is being coverted into a soft magnetic material. Frequency dependent resistivity measurement shows that resistivity decreases with increasing of Cr^{3+} concentration up to x=0.3 and then increases for further dopant. The loss factor increases with increase in Cr content except at x=0.3. The sample for x=0.3, dielectric constant is maximum and permeability value is high, which indicates this sample as a single phase multiferroic material. The result indicated that the substitution of Cr significantly influenced the structural, dielectric and magnetic properties of Co-Zn ferrites.

*Dept of Physics, Jagannath University

1.14 Synthesis and investigation of structural, dielectric and magnetic properties of $Ba_{0.9}La_{0.1}Ti_{1-x}Eu_xO_3$ compounds

M. N. I. Khan, S. M. Hoque, F. M. Kamal, M. R. Hasan, A. Nahar, A. Parveen, A. A. Begum, Z. Begum and A. Khatun*

Objective: The main objective of the work is to Synthesis and Investigation of Structural, Dielectric and Magnetic Properties of $Ba_{0.9}La_{0.1}Ti_{1-x}Eu_xO_3$ Compounds

Current progress: A series of $Ba_{0.9}La_{0.1}Ti_{1-x}Eu_xO_3$ where, x=0.00, 0.02, 0.05 and 0.10 are synthesized by double sintering ceramic method. All the samples are calcined at 800°C for 3 hours and finally sintered at 1200°C for 4 hours. All the samples are observed to be simple cubic in structure according to the X-ray diffraction analysis. The lattice parameter and density increases and porosity decreases with the increase of Eu content up to x=0.05. The porosity of the samples increase for x= 0.1 because of the excess of Eu in the composition. From the Scanning Electron Micrographs, it can be easily noticed that the dopant Eu have a significant effect on grain size and the grain size generally increases with increasing content. The permeability enhances with the increase of Eu on B-site may be due to the decrease of Yafet-KIttel angle which is co-related of the grain size of the samples. The magnetization obtained from M-H curve increases till x=0.05 but decrease for the further substitution of Eu. The dielectric constant increases with increasing frequency but decreases with increasing Eu content from x=0.0 up to 0.5 and again increases for x=0.1because of higher concentration of Eu. The frequency dependence of AC electrical resistivityof the sample $Ba_{0.9}La_{0.1}Ti_{1-x}Eu_xO_3$ where x=0.0 to 0.1 shows that the resistivity increases for x=0.05 with the increasing of Eu content. Hence, enhanced electrical and magnetic properties are hoped to obtain from the $Ba_{0.9}La_{0.1}Ti_{1-x}Eu_xO_3$ceramics.

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1.15 Synthesis and elucidation of structural, morphological, magnetic and electrical properties of Al-substituted $Ba_{0.7}Sr_{0.3}Ti_{1-x}Al_xO_3$ ceramic compositions

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

Objective: The objective of the work is to the Study of the Synthesis and Elucidation of Structural, Morphological, Magnetic and Electrical Properties of Al-Substituted $Ba_{0.7}Sr_{0.3}Ti_{1-x}Al_xO_3$ Ceramic Compositions

Current progress: A number of $Ba_{0.7}Sr_{0.3}Ti_{1-x}Al_xO_3$compositions with different doping concentrations (0%, 5%, 10%, 15%, 20%) were prepared using standard solid state reaction method. All the samples were calcined at 700°C for 4 hours and sintered at 1150°C for 4 hours. From the XRD patterns, it is observed that all the prepared samples are single phased and show good crystallinity. The lattice constant increases for x=0.05 may be because of the inhomogeneous distribution resulting from the initial doping of Al but the homogeneity increases with the increasing doping concentrations resulting in the decrease of lattice constant. The SEM images show that the samples exhibit uniform surface morphology with well-defined grain structure. The change in magnetization with increasing applied magnetic field of the composition $Ba_{0.7}Sr_{0.3}Ti_{1-x}Al_xO_3$ (x = 0, 0.05, 0.10, 0.15, 0.20) also has been investigated with Vibrating Sample Magnetometer and it can be claimed that all the compotions exhibit ferromagnetic properties at room temperature. The real part of dielectric constant decreases with increasing Al content while quality factor, Q increases at higher frequency confirming highfrequency dielectric applications. The highest dielectric Q-factor value is observed for the composition with Al content x=0.05. The real part of permeability decreases up-to x=0.10 may be because of spin disordering and large Yafet-Kittel angle, then increases for further increase in doping concentrations owing to the more ordered spin orientations. The quality factor, Q of permeability increases at high frequency and highest Q-factor value is observed for the composition with Al content x=0.05 indicates the high frequency magnetic applications.

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1.16 Synthesis of $(1-x)BaTi_{0.5}Mn_{0.5}O_3$-$(x)\ _{0.6}Zn_{0.4}Fe_{1.85}O_4$ composites via double sintering ceramic technique and investigation of its multiferroic properties

M. N. I. Khan, S. M. Hoque, F. M. Kamal, H. N. Das, A. Parveen, A. A. Begum, Z. Begum and K. Munny*

Objective: The objective of the work is to Synthesis of $(1-x)BaTi_{0.5}Mn_{0.5}O_3$-$(x)Ni_{0.6}Zn_{0.4}Fe_{1.85}O_4$ Composites via Double Sintering Ceramic Technique and Investigation of its Multiferroic Properties

Current progress: The Series of multiferroic composites of $(1-x)BaTi_{0.5}Mn_{0.5}O_3$-$(x)\ _{0.6}Zn_{0.4}Fe_{1.85}O_4$ NZFSO with x=0.0,0.2,0.4,0.6,0.81.0 have been synthesized by the conventional solid state method. The phase identification has been carried out by using X-ray diffraction (XRD). The XRD analysis revealed that NZFSO and BTMO phases coexist with spinel and tetragonal perovskite structure without interacting with each other. The lattice parameter of BTMO is found to decrease with increasing ferrite content. X-ray and bulk density followed inverse relation. The porosity is noted to decrease with the increasing bulk density indicating a better crystallization. The dielectric dispersion is attributed to the Maxwell Wagner interfacial polarization. A decreasing trend in dielectric constant is observed while the relative quality factor (RQF) increases significantly with the increasing ferromagnetic NZFSO. The saturatin magnetization (Ms) and the coercive field (Hc) show the inverse relation between them. Ms and anisotropy constant (K) is found to increase while Hc decreases with ferrite content. The highest values of coercive foeld ~ 153.395 Oe and the saturation magnetization ~5.25 emu/g were noted for x=0.0 and 1.0 compositions, respectively.

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1.17 Synthesis and chracterization of the structural, electrical and magnetic properties of Calcium, Strontium and Manganese substituted Barium Titanate ($BaTiO_3$) ceramics

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

Objective: The objective of the work is to Synthesis and Chracterization of the Structural, Electrical and Magnetic Properties of Calcium, Strontium and Manganese Substituted Barium Titanate ($BaTiO_3$) Ceramics.

Current progress: Ferroelectric Barium Titanate ($BaTiO_3$) ceramics doped with Ca, Sr and Mg with the general formula of $Ba_{0.4}Ca_{0.4}Sr_{0.2}Ti_{1-x}O_3$ (where x=0.0, 0.05, 0.10, 0.15, 0.20) have been synthesized by solid-state reaction technique and sintered at 1250°C for 4 hours. In this study, Barium Titanate is doped with calcium and strontium at the A-site and manganese at the B-site of the lattice. The X-ray diffraction patterns of all the prepared samples have indicated single phase cubic perovskite structure. Lattice parameter is found to have decreased with the increasing Mn contents (x=0.0-0.10) which follows Vegard's law and then slightly increased with the further increase of Mn contents (x=0.15-0.20). The microstructure of the samples carried out by Scanning Electron Microscope (SEM) showed that the grain growth rate was greatly changed by doping contents (x=0.0-0.10) and slightly decreased with further increasing Mn contents (x=0.15-0.20). All the ceramic materials exhibit dielectric properties within the frequency range of 20 Hz to 100 MHz. The magnetic hysteresis loops observed by Vibrating Sample Magnetometer (VSM) revealed that a significant reduction in the magnetic behavior of Mn doped $Ba_{0.4}Ca_{0.4}Sr_{0.2}Ti_{1-x}O_3$ceramic samples is observed compared to undoped $Ba_{0.4}Ca_{0.4}Sr_{0.2}TiO_3$ ceramic sample. Coercivity is found to be increased up to 10% Mn substitution which indicates that this materials are hard ferromagnetic materials and hard to demagnetize. Then with the further addition of Mn contents coercivity is found to be decreased slightly for 15% Mn substitution and then again increased for 20% Mn substitution.

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1.18 Green Synthesis of bio-molecules encapsulated magnetite nanoparticles and their bio-medical applications

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

Objective: The objective of the work is to Green Synthesis of bio-molecules encapsulated magnetite nanoparticles and their bio-medical applications.

Current progress: Two types of magnetite Nps were synthesized using 50 mL and 90 mL lemon peel extracts (LPE) of the same concentration, respectively. The X-ray Diffraction (XRD) analysis showed that the particles were crystalline with cubic inverse spinel structure for both cases and the crystallite sizes were found to be about 21.1±7.5 nm, respectively. The surface morfhology of the NPs was investigated by Field Emission Scanning Electron Microscopy (FESEM) which showed that the NPs were spherical in shape.Elemental analysis of the NPs was carried out with Energy Dispersive X-ray (EDX) Spectroscopy and it indicated the elemental signature of the presence of iron, oxygen and carbon in the NPs. The Fourier Transform Infrared Spectroscopy (FTIR) analysis showed that the capping agents of the NPs contained the functional groups of alcohol, alkane etc. The percentage of weight loss was about 18% and 10%, respectively for two types of synthesized NPs as found from TGA. The NPs were superparamagnetic in nature with zero coercivity and zero remanent magnetization which was observed using a The syntheized Fe_3O_4NPs were exposed to two type of cell and from the cytotoxicity analysis it was evidenced that the bio-molecules encapsulated Fe_3O_4 NPs were more toxic on cancer cells convincing their deliberate use as antricancer agent.

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1.19 Synthesis and investigation of structural, magnetic and transpor properties of $Ba_{1-x}Zr_xTi_{0.98}Y_{0.02}O_3$ Ceramics

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

Objective: The objective of the work is to Synthesis and Investigation of Structural, Magnetic and Transport Properties of $Ba_{1-}Zr_xTi_{0.98}Y_{0.02}O_3$ Ceramics.

Current progress: Zr doped barium Yttrium titanate $Ba_{1-x}Zr_xTi_{0.98}Y_{0.02}O_3$ (x=0.0, 0.02, 0.05, 0.07, 0.10) perovskite is prepared by conventional solid state reaction method. Zirconium has been doped at the A-site of $Ba_{1-}Zr_xTi_{0.98}Y_{0.02}O_3$ composition. The X-ray diffraction pattern of the prepared samples has indicated tetragonal phase perovskite structure. The density of the prepared samples gradually increased with increasing of Zr content and porosity decreased gradually except x=0.10. Lattice constant of the samples have decreased (except x=0.10) with the increasing Zr contents which follows Vegard`s law. The microstructure of the samples showed that the grain growth rate was greatly changed by doping contents has influenced the dielectric constant within the frequency range of 100 Hz to 120 MHz. The real part of dielectric constant, ε' decreases with increasing Zr content for all the samples. Resistivity increases with with Zr doping which means Eddy Current Loss decreases. n observed as a function of The permeability increases with the increase

of Zr content of the samples which means good magnetic property can be obtained from Zr dopped BYT Ceramics. Increasing trend of relative quality factor and decreasing trend of loss factor with increasing of frequency showing the good characteristics of the compositions. Maximum coercivity is found for x=0.10. The present investigation is a fundamental step for the further improvement of the transport properties if $BaTiO_3$ based ceramics.

*Department of Physics Cumilla University

1.20 Influence of rare earth (Y) ion substitution on the structural, electrical and magnetic properties of Cobalt-Zinc ferrites

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

Objective: The objective of the work is to Influence of Rare Earth (Y) Ion Substitution on the Structural, Electrical and Magnetic Properties of Cobalt-Zinc Ferrites.

Current progress: A series of rare earth Y^{3+} ion substituted Co-Zn ferrites $Co_{0.5}Zn_{0.5}Y_xFe_{2-x}O_4$ (x=0.0 to 0.8 in step of 0.02), have been synthesized by conventional double sintering technique from the oxide powders of Co, Zn, Fe and Y. Single phase of cubic spinel structure has been detected for x>0.06. The lattice parameter initially decreases than increase with yttrium concentrations. The FESEM image shows the grains grains boundaries are distinct and uniformly distributed and the purity has also been endorsed from the EDS spectra. The long range mobility of charge carriers and presence of localized charge carriers with retreat from the Debye-like behavior in the compositions have been explored using electric modulus and impedence. The magnetic strength diminishes owing to existence of magnetic dilution in the A-B interaction subsequent the T_c declines with the x contents. The value of saturation magnetization decreases with increasing Y^{3+} contents that indicates the domain wall motion become tougher due to substitution of foreign ions Y_{3+} that possess larger ionic radius. Therefore, the Y^{3+} substituted $Co_{0.5}Zn_{0.5}Y_xFe_{2-x}O_4$ (x=0.0 to 0.8 in step of 0.02) ferrites with high resistivity and low losses has implications to be used high frequency and power supply devices applications.

*Department of Physics, Chittagong University of Engineering and Technology

1.21 Synthesis, chracterization and properties of graphene reinforced copper doped yttria stabilized Zirconia nanocomposites

M. A. Mamun, S. M. Hoque, M. M. Haque, A. Parveen, Z. Begum, K. M. R. B. Zaman, M. F. Shahriar and S. S. Haque*

Objective: The objective of the work is to Synthesis, Chracterization and Properties of Graphene Reinforced Copper Doped Yttria Stabilized Zirconia Nanocomposites.

Current progress: 3mol% Yttria stabilized Zirconia (YSZ) has been used as a matrix to make the composite materials. In order to enhance electrically conductive property of the composite, copper is used. Graphene is also used to increase both electrical conductivity and structural stability of the composite. YSZ has been doped with 5% copper and sintered at 800ºC and 1000ºC. X-ray diffraction analysis was done to investigate the crystalline structure of the composite.Vickers hardness test was also preformed to explore the hardness of the prepared composite. Resistivity, dielectric properties were also measured. The results show that this hybrid composite could be potentially used where electrical conductivity, thermal resistivity and structural hardness are required such as electrical plug, board inside reactor etc applications.

*Department of Nuclear Science and Engineering Militiary Institute of Science and Technology

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 Electrical and ICT-2018	BES	25-26 Nov. 2018	AECD
	National Conference on Physics, 2019	BPS	7-9 Feb. 2019	Department of Physics, DU
Engr. F. M. Kamal	International Conference on Electrical and ICT-2018	BES	25-26 Nov. 2018	AECD
	National Conference on Physics, 2019	BPS	7-9 Feb. 2019	Department of Physics DU
Dr. M. M. Haque	International Conference on Electrical and ICT-2018	BES	25-26 Nov. 2018	AECD

Name of the person	Title of the event	Organizer	Date	Place
	National Conference on Physics, 2019	BPS	7-9 Feb. 2019	Department of Physics DU
Dr. M. N. I. Khan	International Conference on Electrical and ICT-2018	BES	25-26 Nov. 2018	AECD
	National Conference on Physics, 2019	BPS	7-9 Feb. 2019	Department of Physics DU
Dr. M. Al-Mamun	International Conference on Electrical and ICT-2018	BES	25-26 Nov. 2018	AECD
	National Conference on Physics, 2019	BPS	7-9 Feb. 2019	Department of Physics DU
Dr. H. Das	International Conference on Electrical and ICT-2018	BES	25-26 Nov. 2018	AECD
	National Conference on Physics, 2019	BPS	7-9 Feb. 2019	Department of Physics DU
Dr. Engr. R. Rashid	International Conference on Electrical and ICT-2018	BES	25-26 Nov. 2018	AECD
	National Conference on Physics, 2019	BPS	7-9 Feb. 2019	Department of Physics DU
S. I. Liba	International Conference on Electrical and ICT-2018	BES	25-26 Nov. 2018	AECD
	National Conference on Physics, 2019	BPS	7-9 Feb. 2019	Department of Physics DU
M. R. Hasan	International Conference on Electrical and ICT-2018	BES	25-26 Nov. 2018	AECD
	National Conference on Physics, 2019	BPS	7-9 Feb. 2019	Department of Physics DU
A. Nahar	International Conference on Electrical and ICT-2018	BES	25-26 Nov. 2018	AECD
	National Conference on Physics, 2019	BPS	7-9 Feb. 2019	Department of Physics DU
A. Kumar	International Conference on Electrical and ICT-2018	BES	25-26 Nov. 2018	AECD
	National Conference on Physics, 2019	BPS	7-9 Feb. 2019	Department of Physics DU

3 Training Courses and Seminars Organized

Speaker	Title of the event	Date	Place
Dr. Engr. S. M. Hoque	Hydrooxiapitite-Gelitine-Chitizen prepare by Artificial method	06 Jan. 2019	Materials Science Division
	By using Hydrothermal Autoclave to prepare and analysis Magnetic Hematite	07 Jan. 2019	Materials Science Division
Dr. H. Das	Protein Crystallography Description	20/01/2019	Materials Science Division
Dr. A. Mamun	Carbon Nanotube Synthesis	23/01/2019	Materials Science Division
Dr. B. Lin	Zinom Scequence	30/01/2019	Materials Science Division
M. R. Hasan	Cell Culture	04/02/2019	Materials Science Division

4. Colaboration Work

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

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

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

5. Service Rendered

5.1 Service Provided by XRD

Name of the month	Name of institutions/organizations	Name of samples	No. of samples
July 2018	Dept. of Physics, BUET	Thin Film	01
	Bangladesh Oceanographic Research Institute, Cox's Bazar		15
Aug. 2018	Sreenagar Goods Traders Tongi, Gazipur	Marinade Mix	04
Oct. 2018	ESKAYEF Pharmacuticals Ltd. Murapura, Rupganj, Narayanganj		02
	Dept. of MME, BUET	ZnO	04
	Dept. of BUET	RGO	01
	Dept. of RUET	$CoFeO_4$	01
	Dept. of RUET	NiO	01
Nov. 2018	Dept. of RUET	Tiles	02
Mar. 2019	Dept. of KUET, Khulna	Nano Cellulose	01
	Dept. of CUET	Ferrite	11
	Dept. of KUET	Jute	01
Apr. 2019	Dept. of Renata Ltd.	Tamazepam (APISFP)	04
	Dept. of Rigaku Smart Lab	CuO	01
May 2019	Dept. of Rajshahi University	Cellulose	02
	Dept. of Physics BUET	Ferrite	04
Jun. 2019	DGM. QO, SK+F, Pharmaceuticals Limited.	Docetaxel	01
Total			56

5.2 Service Provided by SEM & EDAX

Name of the month	Name of institutions/organizations	Name of samples	No. of samples
Aug. 2018	Dept. of Sreenagar Goods Traders Tongi, Gazipur	Marinade Mix	02
Oct. 2018	Dept. of MME, BUET	Cu-RGO	04
	Dept. of MME, BUET	Cu-RGO	01
	Dept. of RUET	NiO	01
Nov. 2018	Dept. of leather Engineering, Dhaka University	Leather	01
	Dept. of CI, IA&E, Gazipur	Armura Plate	06
	Dept. of Physics DU	Rice Husk Ash	02
	Dept. of Chemistry, BRUR	Fe_3O_4, Magnetite	02
	Dept. of Geological Sciences, JU	Soil	05
Jan. 2019	Dept. of IA&E, Gazipur Cantonment	Armura Plate	02
	Dept. of MIST, Mirpur	Steel Ingot	01
Mar. 2019	Dept. of EEE, RU, Rajshahi	Thin Film ($SnCl_2$)	01
	Dept. of KUET, Khulna	Jute Fiber	01
	Dept. of CDE, BSMMU, Dhaka	Composite Teeth	04
Jun. 2019	Dept. of Gce, BUET	Yttrium iron Garnet	01
Total =			34

5.3 Service Provided by VSM

Name of the month	Name of institutions/ organizations	Name of samples	No. of samples
July 2018	Dept. of Physics, BUET	FeZnS	01
	Dept. of MME, BUET	MgZn	03
	Dept. of MME, BUET	Thin Film	06
Oct. 2018	Dept. of Physics, BUET	ZnS Thin Film	01
	Dept. of RUET	$CoFe_2O_4$	01
	Dept. of RUET	$BiFeO_3$	03
	Dept. of MME, BUET	$BiFeO_3$	05
	Dept. of Chemistry, SUST	Fe_3O_4, Fe_3O_4 PVP	02
Nov. 2018	Dept. of Physics, BUET	Thin Film	03
Dec. 2018	Dept of Physics, BUET	Thin Film	03
Total			28

5.4 Service Provided by Raman Spectroscopy

Name of the month	Name of institutions/organizations	Name of samples	No. of samples
Dec. 2018	Dept. of Glass and Ceramic Eng. BUET	Powder	01
Jan. 2019	Dept. of Applied Chemistry & Chemical Engineering University of Dhaka	Graphene Oxide	01
Total			02

5.5 Service Provided by Zeta Potential

Name of the month	Name of institutions/organizations	Name of samples	No. of samples
Feb. 2019	Dept. of Applied Chemistry & Chemical Engineering University of Dhaka	Graphene Oxide	01
Feb. 2019	Dept. of Applied Chemistry & Chemical Engineering University of Dhaka	Textile dye Solution	01
May 2019	Dept. of Applied Chemistry & Chemical Engineering Islamic University of Kustia	Silver Nano Particle	06
	Dept. of Applied Chemistry & Chemical Engineering University of Dhaka	Pyrolised nutshell,nutshel	15
Total			23

5.6 Service Provided by PPMS

Name of the month	Name of institutions/organizations	Name of samples	No. of samples
Feb. 2019	Dept. of Applied Chemistry & Chemical Engineering University of Dhaka	Ni Cu Cd ferrite	11
	Dept. of Physics, CUET	Co ferrite	04
	Dept. of Physics, CUET	Co Bismath ferrite	02
Apr. 2019	Dept. of Applied Chemistry & Chemical Engineering University of Dhaka	Ferromagnetic Properties	03
	Dept. of IGCRT, BCSIR, Dhaka	Strontium Ferrite Cobalt Doped Properties	10

Name of the month	Name of institutions/organizations	Name of samples	No. of samples
	Dept. of IGCRT, BCSIR, Dhaka	Strontium Ferrite Titanium and Nickel Doped Properties	10
	Dept. of IGCRT, BCSIR, Dhaka	Strontium Hexaferrite Properties	10
May 2019	Dept. of GCE, BUET	Bismuth Ferrite/ Garnet	04
	Dept. of GCE, BUET	Ce doped 70 $BiFeO_3$ 30 $BaTiO_3$ Ceramic	05
Total			**59**

5.7 Service Provided by Mössbauer

Name of the month	Name of institutions/organizations	Name of samples	No. of samples
Aug. 2018	Dept. of Materials and Metallurgical Engineering, BUET	$BiFe_2O_4$	03
Total			03

5.8 Service Provided by FTIR

Name of the month	Name of Institutions/organizations	Name of samples	No. of samples
Nov. 2018	Dept. of IA&E Gazipur Cantonment	$BiFe_2O_4$	03
Jan. 2019	Dept. of IA&E, Gazipur Cantonment	Armura Plate	01
Mar. 2019	Dept. of EEE, RU, Rajshahi	Thin Film	02
Total			06

5.9 Service Provided by ASS

Name of the month	Name of institutions/organizations	Name of samples	No. of samples
Apr. 2019	Dept. of Chemistry, SUST	One Liquid	03
Total			03

Medical Physics Division, AECD

Objective/Introduction

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

Activities

1. Research and Development Work(s)

1.1 Effect of sampling time and educational status of the lactating mothers on human milk compositions

R. Khatun and S. Akter

There are several factors which may affect the human milk compositions. Among them sampling time and educational status of the lactating mothers is the core interest in this study. In almost all countries, child-death rates are inversely related to the level of maternal education. The study has been conducted to observe whether the human milk varies with sampling time and educational status of the sample providing lactating mothers. The experiments have been done with the 3 MV horizontal type (KN 3000) positive ion Van de Graaff accelerator at the Atomic Energy Center, Dhaka (AECD) by using Ion Beam Analysis (IBA) technique, PIXE. The concentrations of the elements in the afternoon (PM) samples are obtained higher than

those in the morning samples (AM) and concentrations of Zn, Fe and Ca content of breast milk from mothers having educational status Secondary School Certificate (SSC) and above was significantly higher than those of illiterate and primary educated mothers. The measured values of obtained elements are compared with the certified values of Standard Reference and found to be compatible. This article provides an overview of the composition of human milk and sources of its variation pattern with them.

1.2 Study of exposure rates from various nuclear medicine scan at INMAS, Dhaka

R. Khatun, S. Akter and M. Ohiduzzaman*

The aim of present study was conducted to measure external radiation exposures at various distances from the middle body of the patient for various scan. A special type of Gamma camera is used to detect the radiations from patients for having images. In this study the observation was conducted on about 106 patients and a Minirad series 1000#001749 survey meter is used to measure the exposure. It is noted that exposure rates of 99mTc-MDP whole body scan is higher than any other scans and exposure rates are 40.85 µSv/hr at a distance of 0.25 m & 5.97 µSv/hr at 2m distance. On the other hand lower dose rate are observed in 99mTc-DMSA renal scan and found at a distance of 0.25 m is 7.80 µSv/hr & 1.73 µSv/hr at 2m distance. The exposure rates were observed to be significantly varied with the activity of radiopharmaceuticals and it decreases with increasing distance from patient.

* Jashore University of Science and Technology (JUST)

1.3 Metals content in soil sample collected from Narayanganj industrial area, Bangladesh using proton induced x-ray emission

S. Akter and R. Khatun

Soil samples were collected from two different steel industries of Narayanganj District, Bangladesh. The samples were then dried, made fine powder and the pellets have been made for irradiation by 2.2 MeV proton beams of current ranges from 10 to 15 nA. Ion Beam Analyzing (IBA) technique Proton Induced X-ray Emission (PIXE) was used for sample irradiation. Data acquisition has been done using MAESTRO-32 software and the data files are analyzed using GUPIX/DAN-32. Elements to be found in the studied samples are: K, Ca, Cr, Mn, Fe, Co, Ni, Cu and Pd. Heavy metal with higher concentration was found in the study area and the concentration of heavy metal decreases with depth. The main objective of the research work is to explore and identify heavy elements presence in soil samples affected by the industrial area for human health. Higher metal concentration such as lead, iron, nickle, copper, cobalt was found in the study area and the concentration was higher than the background level. Metal concentration in the industrial area was higher than other area. It was observed that most of the heavy metal with high concentration was found from the top soil of the studied area and the concentration of heavy metal is decreases with depth. Constant monitoring of heavy metal pollution caused by different types of industries is needed to reduce such type soil as well as environmental pollution.

1.4 Dosimetric characteristics of medical linear accelerator

S. Akter and R. Khatun

The treatment planning team has to quantify the overall prescribed dose of radiation and determine how much dose will be delivered over the time frame outlined. There are many parameters of photon beam calculation. Monitor unit is a measure of output for linear accelerators. Normally the dose rate for the linear accelerator is 1.0 cGy/MU for a 10 x 10 field size defined at the isocenter. Absorbed dose is measured at a specific point in a medium and refers to the energy deposited at that point. It is measured in gray (Gy). Depth is Distance beneath the skin surface where the prescribed dose is to be delivered. The distance from the source or target of the treatment machine to the surface of the patient is called SSD. The distance from the source of photons to the isocenter is called SSD. In SSD, Isocenter established at the patient's skin surface, when the gantry rotates around the patient, the SSD will continually change and Dose calculations often at DMAX. In SAD, Isocenter established within the patient. The SAD and the isocenter are at a fixed distance and therefore do not change. The intersection of the axis of rotation of the gantry and the axis of rotation of the collimator for the treatment unit is called isocentre. The physical size set on the collimator of the therapy unit that determines the size of the treatment field at a reference distance (defined at the machine's isocenter) is called Field size. In SSD, field size set on the collimator will be the same measured at the patients skin and in SAD, the field size set inside the patient (size measured on patients skin will be smaller). The point where dose

reaches its maximum value (depth of maximum ionization) is called Dmax. Output of a machine is the amount of radiation exposure produced by a treatment machine or source as specified at a reference field size and at a specified reference distance. There are also different Tissue Absorption Factors. All theses parameters are involved in Photon Beam calculations.

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

Name of the participant	Title of the event	Organizer	Date	Place
Dr. R. Khatun	National Conference on Physics-2019	BPS	07-09 Feb. 2019	DU
	National Conference of Society of Nuclear Medicine, Bangladesh	SNMB	22 Mar. 2019	Narayanganj
S. Akter	National Conference on Physics-2019	BPS	07-09 Feb. 2019	DU

3. Collaboration Work/MoU

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

4. Others

- Lecture delivered on FTC training course on "Nuclear and Radiological Emergency Preparedness Course at BAEC (NREPCB-7)-2018
- Seminar on Medical Physics in Bangladesh, 25 September, 2018, organized by Institute of Nuclear Medical Physics (INMP), AERE, Savar, Dhaka
- Seminar on "Dosimetric Charateristics of Themoluminiscence Material", 18 September 2018, organized by Institute of Nuclear Medical Physics (INMP), AERE, Savar, Dhaka
- Training cum Seminar on "Uses of IMRT thorax phantom", 04 Decebmer, 2018 organized by Institute of Nuclear Medical Physics (INMP), AERE, Savar, Dhaka
- Training cum Seminar on "Dosimetry of Medical Linac", 11 December 2018, organized by Institute of Nuclear Medical Physics (INMP), AERE, Savar, Dhaka
- Training cum Seminar on "How to guide M. Sc./ Ph. D. Students", 25 March 2019, organized by Institute of Nuclear Medical Physics (INMP), AERE, Savar, Dhaka
- Training cum Seminar on "Public Procurement Rule 1", 23 April 2019, organized by Institute of Nuclear Medical Physics (INMP), AERE, Savar, Dhaka

5. Service Renderd

5.1 Experts Services

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

5.2 Equipment Services

- Commissioning, Setup, Calibration, Acceptance testing, QA and QC
- Repair, Maintenance and Prepare technical specifications of medical equipments

Non-Destructive Testing Division, AECD

Objective

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

Program(s)

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

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

Activities

1 Research and Development Work(s)

1.1 Development of technical working procedures of NDT methods

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

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

Depending on the geometry, dimension, orientation of the components, service condition, anticipated defect nature in the component and applicable codes & standards, the working procedures were developed for the inspection of different equipment used in various industrial sectors viz. Gas transmission and Distribution Line, Fertilizer Factory, Gas Processing Plant, Steel Structure, High Pressure Gas Pipe Line, Railway, Ordnance Factory, Power Plant, Shipbuilding, BITAC, Sugar Mills, Bangladesh Air Force etc.

1.2 Corrosion evaluation and wall thickness measurement in insulated pipes by tangential radiography

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

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

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

1.3 Development of eddy current testing technique for heat exchanger tube

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

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

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

1.4 Digital industrial radiographic method for industrial practices

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

The scope of this work is to make the digital image of an object onto the imaging plate by the ionizing radiation and processing the image with the aid of appropriate computer facility in order to enhance their

contrast & spatial resolution and to sharpen and smothen their edge definitions for analysis of object structures.

Using X-ray Source Digital image of welded plates and mortar shells were analyzed to assess the integrity by adjusting different parameters available in the I See! Software.

2. Manpower Development and Training Program

2.1 Arrangement of National Training Course on NDT

Title of the event	Date	Place	No. of participant
80th National Training Course on Ultrasonic Testing Level-1	16 July – 02 Aug. 2018	NDT Division, AECD	14
81st National Training Course on Ultrasonic Testing Level-1	03 – 20 Sept. 2018	NDT Division, AECD	14
82nd National Training Course on Ultrasonic Testing Level-1	08 – 25 Oct. 2018	NDT Division, AECD	13

2.2 Arrangement of Customized Training Course on NDT

Title of the event	Date	Place	No. of participant
Training Course on Radiographic Film Interpretation	08 – 12 Jul. 2018	NDT Division, AECD	05
Training Course on Welding and Non Destructive Testing	27 – 31 Jan. 2019	NDT Division, AECD	16

2.3 Arrangement of Seminar

Title of the event	Date	Place	No. of Participant
AECD-Industrial Engineering Services Seminar on "Ensure Safety, Reliability & Efficiency of Industries through NDT"	06 Feb. 2019	AECD	72

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

Name of the participant	Title of the event	Organizer	Date	Place
M. F. H. Chowdhury	Regional Workshop on Non-Destructive Testing (NDT) Examination Qualification and Certification Scheme Requirements in Accordance with the Latest Edition ISO 9712 and ISO17024 (RAS 1022)	IAEA	06 – 10 May 2019	Manila, Philippines
	Final Project Coordination Meeting and Workshop on Infrastructure for Non-destructive Testing (RAS 0081)	IAEA	10 – 14 Jun. 2019	Christchurch, New Zealand
M. A. Habib	IAEA/RCA Training Course on Radiographic Testing RT-D Level 2 for Personnel Certified to Radiographic Testing RT-F Level 2 (RAS 1022)	IAEA	10 – 21 Jun. 2019	Kajang, Malaysia
M. S. Ashraf, A. Rahim	Basic Nuclear Orientation Course (BNOC)-2018 (2nd Batch)	BAEC	09 Sept. 01 Nov. 2018	BAEC

4. Collaboration Work(s)

4.1 IAEA Projects

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

"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)".

4.2 Basic Training for BAF Officers'

During this reporting period, the concerned persons of the NDT Division delivered theoretical lectures on different NDT methods to the 61st & 62nd 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 4 participants from Royal Jordanian, 3 participants from Srilanka, 1 participant from India, 2 participants from Pakistan, 1 participant from Malaysia & 1 participant from USA Air force were present in these courses. The NDT Division also conducted day long practical demonstration class for the above courses. This collaboration is likely to be continued.

5. Practical Demonstration for University Students

Within this reporting period, NDT Division of BAEC arranged Practical demonstration on different NDT methods to the course "Non Destructive Testing and Machine Condition Monitoring Sessional" (Course Code: NSE410) for 40 students of Level – 4/Term – 1 of Department of Nuclear Science and Engineering, Military Institute of Science and Technology (MIST) to provide application based knowledge on NDT methods as a part of their curriculum activities.

6. Internship Program on Industrial Training for University Students

BAEC has collaboration with different universities to extend R & D program to attain sustainability and to promote technology in the country. Within this reporting period NDT Division of BAEC has conducted three weeks long Internship Program on Industrial Training as a part of the curriculum activities for 2 B.Sc. students of 3rd year, Department of Nuclear Engineering, University of Dhaka in 2019 to provide familiarization and application based knowledge on NDT methods.

7. Non Destructive Inspection at Russian Federation for the equipment of Rooppur Nuclear Power Plants

The Experts of NDT Division were deployed at various Nuclear Equipment Manufacturing Plants located at different parts of Russian Federation in order to supervise the Quality of Fabrication work & Non Destructive Inspection of Long Term Manufacturing Equipment (LTME) for the under-constructed Rooppur Nuclear Power Plants.

8. Service Rendered and Revenue Income

No. of service given to the organization	Nature of service	No./quantity of sample	Income
Energypac Power Generation Ltd.	• Consultancy Services to the "4000 BPDCFP Project" of Sylhet Gas Fields Ltd., Rashidpur, Bahubal, Habiganj • Review of Radiographic Film and Test Reports of 4000 BPDCFP Project of Sylhet Gas Fields Ltd.	• 01 man month • 38 Nos.	1,00,555/-
Max Infrastructure Limited	Magnetic Particle & Ultrasonic Testing of Alumino-thermic Welding Joints of Rail Pieces of Bangladesh Railway, Rajshahi	03 Nos.	15,000/-
Buildtrade Engineering Ltd.	Calibration of Ultrasonic Flaw Detector	01 No.	3,000/-
Bay-Tech NDT & Engineering Services	Calibration of Ultrasonic Thickness Gauge	01 No.	2,000/-
Bangladesh Industrial X-ray	• Calibration of Ultrasonic Flaw Detector • Ultrasonic Testing of welding joints of Pipe of Dhanua-Nalka 30″Gas Pipeline Project of GTCL	• 02 Nos. • 01 No.	16,000/-
I A & E	Radiographic Testing of Mortar Shell	2 Nos.	2,000/-
4 times to IPCO	Ultrasonic Testing of Welding joints of Glass lift Project	• 16 Nos.	73,310/-

No. of service given to the organization	Nature of service	No./quantity of sample	Income
Developments (Bangladesh) Ltd. & IPCO Hotels Ltd.	of Retail Building, Beams of Banquet Hall, Garden Roof, Roof Top Canopy etc. of IPCO Developments (BD) Ltd. at Airport Kurmitola Project.	• 25 Nos. • 81 Nos. • 68 Nos.	
Steelmark Buildings Ltd.	Ultrasonic & Radiographic Testing of Welding joints of Plates	20 Nos.	17,500/-
Western Marine Services Ltd.	• Calibration of Ultrasonic Flaw Detector • Calibration of Ultrasonic Thickness Gauge	• 01 No. • 02 Nos.	7,000/-
IVY Trading International	Industrial Videoscope Inspection of Reheater 1 Outlet to Reheater 2 of Bheramara CCPP (360MW)	01 No.	50,000/-
Bangladesh Air Force	Ultrasonic Thickness Test of Vertical fin of MIG-29UB aircraft (serial no. 375)	01 No.	5,000/-
BITAC, Dhaka	Ultrasonic Testing of Journal Bearing	07 Nos.	14,880/-
BSC Marine & Grain Conveyor Workshop	Radiographic Testing of Welding joints of Pipes and Plates	08 Nos.	5,600/-
Saj Industrial & Inspection Company	• Calibration of Ultrasonic Flaw Detector • Calibration of Ultrasonic Thickness Gauges • Calibration of Electromagnetic Yokes • Calibration of UV Light	• 02 Nos. • 02 Nos. • 03 Nos. • 01 No.	17,000/-
BETS Consulting Services Ltd.	NDT Consultancy Services to " 30 inch dia 66km long Dhanua - Elenga Gas Pipeline Construction Project" of Gas Transmission Co. Ltd. Financed by JICA through BETS Consulting Services Ltd. a local representative of international consultant PENSPEN, UK under the agreement between AECD & BETS for 18 months	03 man month	1,60,000/-
Bashundhara Steel & Engineering Ltd.	• Calibration of Ultrasonic Flaw Detector • Calibration of Ultrasonic Thickness Gauge	• 01 No. • 01 No	5,000/-
Modern Steel Engineering	Ultrasonic Testing of Shaft for Salzgitter Centrifugal Machine of Zeal Bangla Sugar Mill	01 No	2,280/-
Highspeed Group of Companies	• Magnetic Particle Testing of Welding joints of Dredger • Liquid Penetrant Testing of Welding joints of Dredger • Radiographic Testing of Welding joints of Dredger	• 06 Nos. • 04 Nos. • 27 Nos.	24,600/-
Jamuna Fertilizer Company Ltd.	Consultancy Service on NDT	03 man day	10,000/-
Newtech Enterprise	Calibration of Ultrasonic Thickness Gauge	01 No.	2,000/-
NDE Steel Structures Ltd.	• Calibration of Ultrasonic Flaw Detector • Calibration of Ultrasonic Thickness Gauge • Calibration of Electromagnetic Yoke • Calibration of UV Light	• 01 No. • 01 No. • 01 No. • 01 No.	8,000/-
PEB Steel Alliance Ltd.	• Calibration of Ultrasonic Flaw Detector • Calibration of Ultrasonic Thickness Gauge	• 01 No. • 01 No.	5,000/-
Advanced Technic & Inspection Co Ltd.	• Calibration of Ultrasonic Thickness Gauge • Calibration of Electromagnetic Yoke	• 01 No. • 01 No.	4,000/-
Total			5,49,725/-

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 work(s) in the field of health, environment, agriculture and industry, (d) detection & analysis of radionuclides using 'Gamma Spectroscopy System'

Program

Accelerator Facilities Division of the Atomic Energy Centre, Dhaka operates and maintains the 3 MV Van de Graaff Accelerator and its associated sub-systems, which is capable of producing and accelerating proton beam in the range of nano to micro-amperes. The proton beam & associated facilities are being utilized for elemental analysis of environmental, health, biological, agricultural and industrial specimens. This division has also been developed a 'Gamma Spectroscopy System' using existing HPGe detector, Lead shielded chamber, spectroscopy amplifier, MCA and associated other electronic units. The system is being used for the detection and analysis of radionuclides and their activity accumulated in various specimens of the earth surface.

Activities

1. Research and Development Work(s)

1.1 Operation and management of the 3 MV Van de Graaff Accelerator

M. J. Abedin, M. M. Ahasan and M. M. Rahman

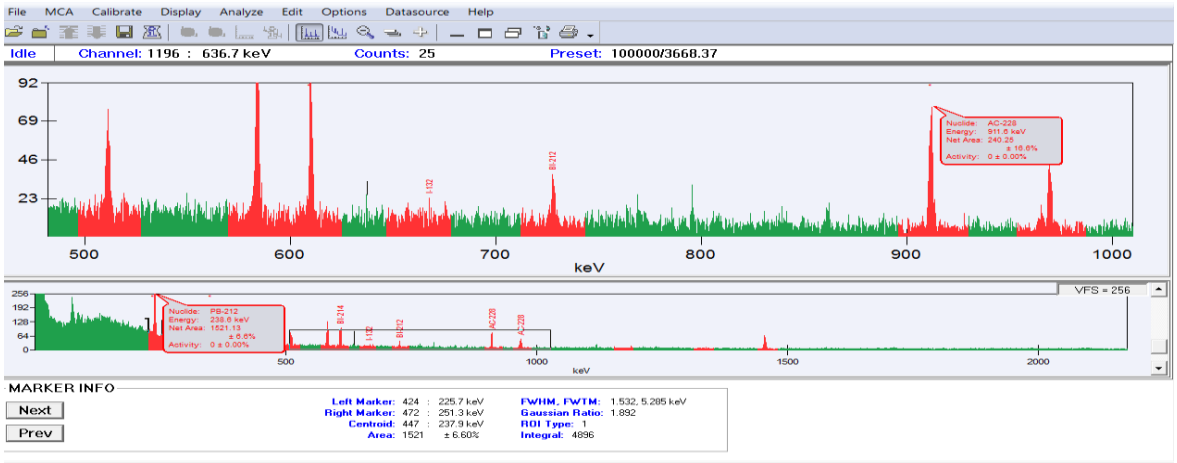
Objective: The main objective is to keep the accelerator operational, to produce and accelerate the proton beam for research purpose. Routine maintenance of the accelerator is also included in this program.

Current progress: Now the accelerator is in operation. According to the user's demand, the accelerator has been operated to produce and accelerate the proton beam for irradiation of different specimens. For quantitative measurements of both the essential and toxic elements of foodstuff like vegetables, fruits, and milk samples. Specimens collected from Cox's Bazar Sea Beach area, medicinal plants, soil and vegetables have been dried, ground and prepared as pellets. Radionuclide detection and analysis of the samples collected from waterfall area, from local market have also been done using 'Gamma Spectroscopy System' of AFD. The students of different universities have been done their thesis experiments for MS, MPhil and PhD degrees using PIXE and Gamma spectroscopy techniques with the collaboration of VDG Accelerator laboratory.

1.2 Elemental analysis and pollution assessment of soil samples of Chattogram and Cox's Bazar Sea beach area

M. J. Abedin, M. M. Ahasan, M. M. Rahman and L. Jaman*

Objective: The objective of the research work is to detect the pollutants (heavy metal & radionuclides) of Cox's Bazar Sea Beach area of Bangladesh using PIXE and Gamma spectroscopy techniques. The goal is to determine the exact quantification of essential and toxic elements and radionuclides accumulated in soil and to provide sufficient information to evaluate its impact on human health and the environment.



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

Current progress: 40 samples (350gm each) have been collected from Cox's Bazar Sea Beach area. Experiments for radionuclides detection have been done by 'Gamma Spectroscopy System' for all of the samples. Energy lines of different radionuclides detected and analyzed by Genie-2000 software from a sample are shown in figure above.

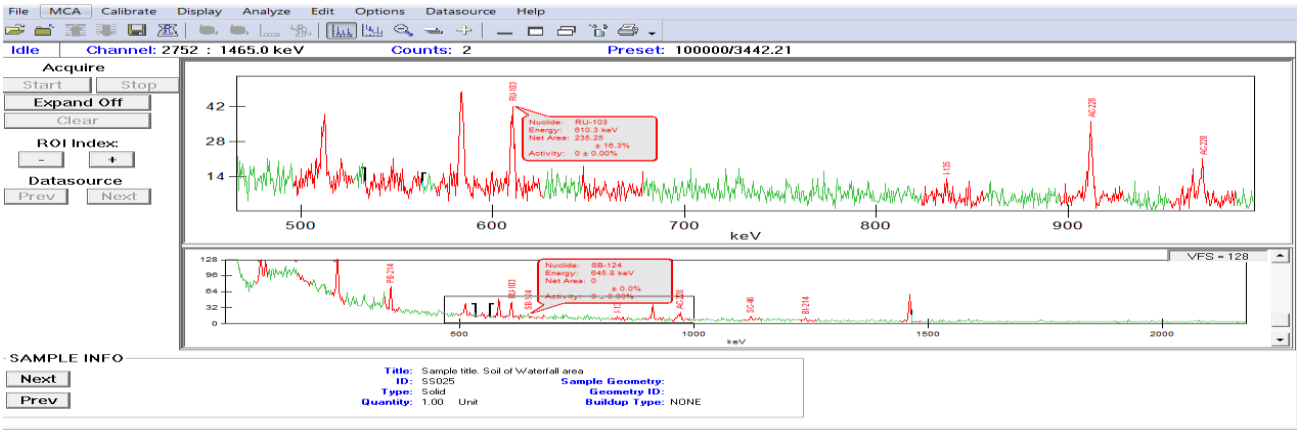
* Department of Physics, Jahangirnagar University, Savar.

1.3 Quantitative analysis of trace element in fishes and sediments of polluted lakes in Dhaka city using IBA techniques and radioactivity measurement of lake sediment

M. J. Abedin, M. M. Rahman, M. M. Ahasan and M. A. Rahman*

Objective: The main objective of the research work is the detection and analysis lake sediment of Dhaka city and determination of heavy metal accumulation in fishes.

Current progress: Lake sediment samples were collected from Gulshan lake and experiments were done by 'Gamma Spectroscopy' data acquisition setup. Spectrum data has been collected using MCA (MP2 CANBERRA) and Gamma Acquisition Software 'Genie-2000'. One of the detected & analyzed spectrum file is projected below:



A PhD degree has been awarded under this research program.

* Department of Physics, Jahangirnagar University, Savar.

1.4 Assessment of elemental concentration and radioactivity of baby food collected from local market using PIXE and gamma spectrometry techniques

M. J. Abedin, M. M. Rahman, S. Akter, M. M. Ahasan and Suvrajit Roy*

Objective: The main objective of this research work is to analyze the elements contain in the baby foods available in the local markets. The research work is also involved for the detection & analysis of radionuclides contaminated in baby foods.

Current progress: Different types of baby food have been collected from local market, dried, ground and made as pellet (7mm diameter & 1mm thick). The pellets have been irradiated by 2.4 MeV proton beam and with the beam current of 10 to 15 nA. The data acquisition were done by PIXE technique and using MAESTRO-32 software. The data file has been analyzed for elemental assessment. MS thesis has been prepared and submitted under this program to the department of Computer Science and Telecommunication Engineering, Noakhali Science and Technology University.

* Department Computer Science and Telecommunication Engineering, Noakhali Science and Technology University.

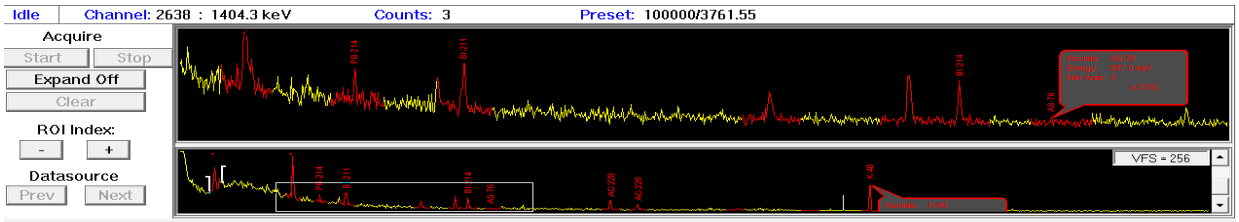
1.5 Assessment of environmental toxicity of some waterfall areas Bangladesh by PIXE technique and radionuclide detection using gamma spectrometry

M. J. Abedin, M. M. Rahman, M. M. Ahasan and M. Safiul Islam*

Objective: The objective of this research work is to study the environmental toxicity of waterfall areas due to heavy metal and radionuclides accumulation and to assess its radiological effects on human health.

Current progress: Samples have been collected from different waterfall areas of Sylhet and Chattogram and preserved for nuclide detection using 'Gamma Spectroscopy System'. A portion of each of the sample has

been taken, dried, ground to make fine powder and finally pellets were made for PIXE experiments. Gamma spectrum data acquisition has been done using 'Gamma Spectrometry' and Genie-2000. One of the analyzed gamma data file has been shown in below.



	Peak No.	ROI start	ROI end	Peak centroid	Energy (keV)	FWHM (keV)	Net Peak Area	Net Area Uncert.	Continuum Counts
	1	123-	151	138.94	73.96	1.98	5.087E+02	108.13	2.413E+03
	2	438-	462	447.98	238.48	1.51	7.827E+02	76.67	1.231E+03
M	3	499-	566	507.87	270.36	1.69	-8.741E-01	49.41	4.371E+02
m	4	499-	566	554.20	295.03	1.77	-1.963E+00	110.98	4.025E+02
M	5	625-	671	635.15	338.12	1.72	1.153E+02	6.68	2.802E+02
m	6	625-	671	660.36	351.54	1.76	1.830E+02	7.28	3.022E+02
	7	814-	835	824.76	439.06	0.74	3.247E+01	36.51	3.455E+02
M	8	900-	971	910.46	484.67	4.54	5.494E+01	1.90	3.328E+02

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

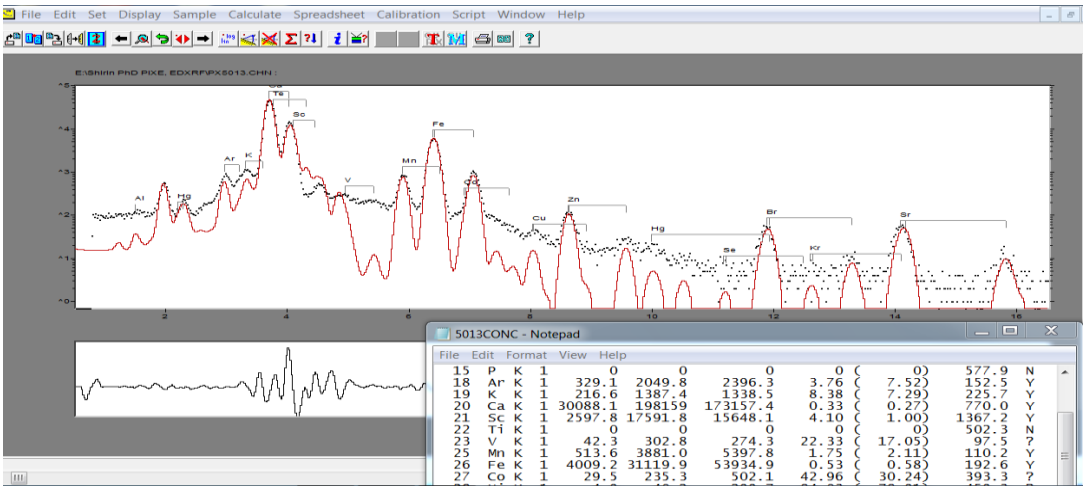
* Department of Physics, Jahangirnagar University, Savar.

1.6 Analysis of toxic elements in different foodstuff using PIXE and EDXRF techniques, radionuclide detection and possible health risk assessment

M. J. Abedin, M. M. Rahman, M. M. Ahasan and S. Akter*

Objective: The objective of this research work is to analyze the elements and radionuclides contain in imported and locally produced foodstuffs and their health risks assessment.

Current progress: Different types of milk, fruit and vegetable samples have been collected from local market, dried, ground and made as pellet (7mm diameter & 1mm thick). The pellets have been irradiated by 2.4 MeV proton beam and with the beam current of 10 to 15 nA. The data acquisition were done by PIXE technique and using MAESTRO-32 software. The data file has been analyzed for elemental assessment. Most of the samples have been taken under gamma experiments for the detection and analysis of radionuclides. The PIXE spectrum data file of one of the vegetable sample is shown in below.



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

* Department of Physics, Jahangirnagar University.

2. Repair & Maintenance and Renovation Works

Routine maintenance has been done on a number of sub-systems of 3MV VDG Accelerator.

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

Name of the participant	Title of the event	Organizer	Date	Place
M. M. Rahman	PPR 2008 and Public Procurement Management	BIM	07-18 Oct. 2018	Dhaka
	e-GP System for the PE	Ministry of Planning	13-15 Nov. 2018	Dhaka
	FDG Production from Cyclotron and its synthesis	ICT	25-26 Nov. 2018	Dhaka
	Dosimetry and Treatment Planning	SCMPCR	04-06 Oct. 2018	Dhaka

Plasma Physics Division, AECD

Objective/Introduction

The plasma physics division is the newest division of the Atomic Energy Center, Dhaka (AECD) which is started to work in 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, Astrophysical plasma, Industrial plasma, Fusion plasma, etc.

Activities

1. Research and Development Work(s)

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

M. A. Malek, M. R. Haque, M. K. Islam, M. S. S. Chowdhury and M. Hassan

Current progress: A dense plasma focus (DPF) is a high pulsed co-axial accelerator that produces a high-density, high-temperature plasma along with pulsed x-rays, neutrons, electrons, ions and electromagnetic waves. The plasma focus device is composed with two sections: The first section is pre-pinch (axial) section and the second one is the radial pinch phase section. We have studied the fusion neutron and soft X-ray production from a low energy DPF as a function of pressure and the dimension of electrodes.

Study on the Fusion Neutron Production: From the numerical experiment, a basic understanding has been acquired about the working principle and neutron production of a miniature device with different filling gas pressure. Correlation of neutron yield with plasma focus properties – like pinch current, peak current, maximum induced voltage, axial speed, radial piston speed, shock speed, plasma ion density, pinch duration - are understood as a function of pressure. It has been observed that the production of fusion neutron maximizes in the pressure where pinch current maximizes. It is also observed that pinch length is constant with respect to pressure; pinch radius increases with pressure; Plasma temperature, axial and radial speed of plasma sheath increase with the decrease of pressure; plasma ion density and pinch duration increases with pressure.

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

1.2 Theoretical and computational studies on quantum plasma

M. S. S. Chowdhury

Current progress: Research on quantum plasma has been started to understand the more accurate description of metallic properties, the metallic nanostructures (metal clusters, nanoparticles, thin metal films, etc.), and the physics of semiconductor and also to understand astrophysical objects under extreme conditions of temperature and density.

The density functional theory (DFT) is presently the most successful (and also the most promising) approach to compute the electronic structure of matter. Its applicability ranges from atoms, molecules and solids to nuclei and quantum and classical fluids. In its original formulation, the density functional theory provides the ground state properties of a system, and the electron density plays a key role.

In recent years Warm Density Functional Theory (WDFT), a modified version of DFT, is attracting interest of scientific community to understand different properties of Quantum Plasma. We have studied theories and literatures on WDFT and already planned theoretical approach for the calculation of the dielectric function (DF), reflectivity, conductivity, plasma frequency and effective free electron density of warm dense matter (WDM).

1.3 Design and development of an atmospheric pressure plasma devise

M. Hassan

Current progress: The pressure of Atmospheric-pressure plasma approximately matches that of the surrounding atmosphere. Atmospheric-pressure plasmas have prominent technical significance because in contrast with low-pressure plasma or high-pressure plasma no reaction vessel is needed to ensure the maintenance of a pressure level differing from atmospheric pressure. The objective of design and development of atmospheric pressure plasma system is for industrial application such as Sterilization, Gas decomposition, Biomedical application, Mutation breeding. The proposed equipment to be needed for this research are Radio frequency (RF) power supply, Oscilloscope, DC power supply, Capillary tube, Plasma needle and others auxiliaries tools.

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

Name of the person	Title of the event	Organizer	Date	Place
Dr. M. K. Islam	Cause and Diseases in Homeopathy: Quantum Physics Perspective	Atomic Energy Centre, Dhaka	13 May, 2019	AECD

3. Manpower Development and Training Program

Title of the event	Date	Place	No. of participant
Industrial Training (Dept. of Nuclear Engineering, DU)	05-26 Aug. 2018	AEC Dhaka	02
Industrial Training (Dept. of Nuclear Engineering, DU)	01-15 May, 2019	AEC Dhaka	01

4. Collaboration Work

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

ATOMIC ENERGY RESEARCH ESTABLISHMENT (AERE), SAVAR

CENTRE FOR RESEARCH REACTOR (CRR), AERE

Objectives/Introduction

Bangladesh Atomic Energy Commission (BAEC) TRIGA research reactor is the only nuclear reactor in the country. It has a maximum steady state thermal power of 3 MW. The reactor achieved its first criticality on 14 September 1986. The reactor has so far been used in various fields of research and utilization such as, manpower development for nuclear power program in the country, Neutron Activation Analysis (NAA), Neutron Radiography (NR), Neutron Scattering (NS), experimental reactor safety research, education, training etc. Center for Research reactor (CRR) is responsible for the operation and maintenance of the reactor and its associated equipment and systems with ensuring appropriate level of safety as delineated in the Safety Analysis Report (SAR). CRR is also responsible for the preparation of various Safeguards and Additional

Protocol related reports for AERE facilities on routine basis. These reports are sent to the IAEA through Nuclear Safety, Security and Safeguards Division (NSSSD) and International Affairs Division (IAD) of BAEC.CRR is now working on an ADP project entitled, "Balancing, Modernization, Refurbishment and Extension (BMRE) of Safety Systems of the 3 MW TRIGA Mark-II Research Reactor Facility at AERE, Savar, Dhaka". The main objectives of the project are to increase operating life of the reactor (about 15 to 20 years) by implementing ageing management of different system/components of the reactor.

Activities/Program

1. Research and Development Work(s)

During the reporting period the reactor was operated at power levels of 50 W to 2400kW 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 175 and total burn up of the reactor fuel was about152MWh. A total number of 1177 samples were irradiated through 74 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 High Performance Powder Diffractometer (HPPD) has been set up at the reactor to enhance the R&D facilities in neutron scattering technique. Structural studies of materials are being done by this 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 program for students from different universities as well as for trainee from BAEC training institute.

2. Manpower Development and Training Program

Title of the event	Date	Place	No. of participants
Emergency Evacuation Drill [for CRR Personnel]	10 Jul. 2018	CRR	28
Emergency Fire Drill [for CRR Personnel]	10 Jul. 2018	CRR	28
Training on Fire Hazards and Extinguishment	12 Jul. 2018	CRR	25
Practical Class [for the Students of Reactor Operation and Experiment Lab (NE-4202) Course, B.Sc. 4th Year, 1st Batch, Department of Nuclear Engineering, Dhaka University]	22-26 Jul. 2018	CRR	20
Industrial Training [for the Students of 4th Year, 1stsemester students of Mechanical Engineering Department, Dhaka University of Engineering Technology (DUET)]	03-20 Sept. 2018	CRR	17
Industrial Training [for the Students Level-4, Term-1, Department of Mechanical Engineering, Bangladesh University of Engineering Technology (BUET)]	02-22 Oct. 2018	CRR	03
Industrial Training [for the Students of B.Sc. Engineering, Department of Electrical & Electronic Engineering, Islamic University of Technology (IUT)]	26 – 29 Nov. & 02 – 05 Dec. 2018	CRR	95

Title of the event	Date	Place	No. of participants
Industrial Training [for the Students of B.Sc. 3rd Year, Department of Nuclear Engineering, Military Institute of Science & Technology (MIST)]	19 –26 Dec. 2018	CRR	40
Practical Class (Reactor Operation and Experiment Lab (NE-4202)) [for the Students of B.Sc. 2nd Batch 4th Year 2nd Semester, Session 17-18, Reactor Operation and Experiment Lab (NE-4202) Dept. of Nuclear Engineering, Dhaka University]	21-29 Apr. 2019	CRR	18
Industrial Training [for the Students of B.Sc. 3rd Batch, 3rd Year, Department of Nuclear Engineering, University of Dhaka]	16-29 Apr. 2019	CRR	02
Project Work [for the Students of B.Sc.(honors), Department of Physics, Pabna University of Science and Technology]	01 Jun. -30 Aug. 2019	CRR	02
In-house training for CRR Personnel [In every month 2/3 classes are healed according to training schedule.]	01 Aug. 2018-30 Jun. 2019	CRR	429

3. Collaboration Work(s)

- TC Project (Ongoing): Strengthening operational safety, design & development of spent fuel storage facility of the BAEC TRIGA research reactor and capacity building for the design of a thermal hydraulics and reactor safety testing laboratory
- ADP Project (Ongoing): Balancing, Modernization, Refurbishment and Extension (BMRE) of Safety Systems of the 3 MW TRIGA Mark-II Research Reactor Facility at AERE, Savar, Dhaka. Under this project several systems of the BTRR are being upgraded for the purpose of long term (about 15-20 years) operation of the BTRR.
- ADP Project (Ongoing): Technical Study/Survey Project to Establish High Power Research Reactor in Bangladesh

4. Repair & Maintenance and Renovation Works

Some of the non-routine maintenance works performed during the reporting period is listed below

Jul. 18	• Secondary Pipeline Strainer Cleaning: Secondary pipeline water was removed; strainer was cleaned and primed the secondary pump • 4 (four) 12v-7.5A batteries of reactor control console UPS were replaced by 12V-26A batteries • Repair and maintenance of CC Camera was done carefully
Aug. 18	• Maintenance of the cooling tower: Mechanical cleaning were undertaken as per schedule to remove the deposited soft sludge and scale from the basin and secondary pipe to minimize the fouling effect in secondary cooling system • Monthly maintenance check list of all electrical systems of CRR were performed effectively
Sept. 18	• Secondary pipe line Strainer cleaning & maintenance was done effectively • Resin of water treatment plant was changed carefully • Quarterly Surveillance program was performed efficiently
Oct. 18	• Pipe line maintenance of On-line purification system was done carefully • Maintenance of Service water line of reactor overhead tank was performed carefully • 250kVA Diesel Generator Maintenance: N-150 Battery, Battery clamp were replaced • Repair and maintenance of 110v motor (coil welding) of On-line purification system was done
Nov. 18	• Pressure Gauge of secondary water cooling system was well replaced

	• Quarterly Surveillance program was performed • The replacement work of Silica gel of Substation Transformer (11kV-440V) was done
Dec. 18	• Annual maintenance and surveillance activities were performed for the following mechanical systems: Primary pumps, Secondary pumps, 250 kVA & 650 kVA Generators, Water treatment plant, Fire pump, 10 HP pump, Ventilation system etc. • Defective blower motor for Stack Monitor was replaced by an old good one • Repaired and installedthe security lights of the reactor hall and outside area of the reactor building
Jan. 19	• The maintenance work of reactor On-line Purification Pump was done carefully. • Monthly check list and maintenance works were performed
Feb. 19	• Cleaning and maintenance work of Cooling Tower: The Cooling Tower Sump was cleaned, greasing of the cooling tower fan (CT-1 & CT-2) was done carefully along with priming of Secondary Pump & pipe line • Vibration monitoring: Primary and secondary pumps and motors vibration were measured to check the operating condition of the system • New internet router was installed
Mar. 19	• Inspection and maintenance of the water based fire protection system: Inspection and churn test of the electric driven fire pump and associated systems were performed to ensure fire pump reliability • Quarterly Surveillance program was performed • The load test of 5-ton overhead crane was performed by using 100 % and 120% load (both static and dynamic test). Mechanical structure condition of the crane is in good. Apart from safety reliability of the crane, electrical system with hoist unit must be upgraded for smoother operation • The battery of 250kVA diesel generator was replaced by new one • A new intercom system was installed under ADP Project of CRR entitled as "Balancing, Modernization, Refurbishment and Extension (BMRE) of the safety system of BTRR"
Apr. 19	• Secondary Pipeline Strainer Cleaning: Secondary pipeline water was removed; strainer was cleaned with priming of the secondary pump • The video surveillance system for outside of the reactor hall made functional by installing software and configured hardware • Six (06) metal light shades were repaired • A new six zone Public Address System has been installed at CRR under BMRE project
May 19	• 10 HP pump maintenance: Lube oil, Rubber gasket were changed • The central A/C of BTRR was made operational by replacing old compressor (20 ton) and repairing of blower motors. The renovation works for central A/C were performed under the ADP period • A 63 Amp MCCB SP circuit breaker was replaced by a MCCB TP at the output side of the 110V AC transformer in E/M duct room • Seventy percent works of repair, maintenance and modification of air tight door for reactor hall were conducted under the BMRE project
Jun. 19	• The maintenance work of 250 kVA diesel generator was done successfully • The battery charger of 250 kVA diesel generator was repaired • Semi-annual surveillance program was performed carefully

INSTITUTE OF NUCLEAR SCIENCE AND TECHNOLOGY (INST), AERE

Radioisotope Production Division, INST

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

Activities

1. Research and Development Work(s)

- Test production of different cold kits like DTPA, DMSA and MDP
- Gamma Radiation Shielding Efficiency study for locally available beach sand minerals based composite materials
- Use of Chitosan as potential adsorbent material for $^{99}Mo/^{99m}Tc$ Generators
- Effect of Radioactive Concentration of $Na_2{}^{99}MoO4$ on Chromatographic $^{99}Mo/^{99m}Tc$ Generator

2. Repair & Maintenance Work

- Operation & maintenance of the cGMP complaint computer controlled on-line Tc-99m generator production facility at RIPD and I-131 Production Plant
- Maintenance of Non-pyrogenic Water Production Plant, Hot Air Sterilizer, Steam Sterilizer.
- Operation and Maintenance of Evacuation chamber for vacuum vial preparation.
- Operation & Maintenance of HPGe
- Operation & Maintenance of peristaltic pump.
- Operation & Maintenance of Tc-99m Cold Kit Production Facility
- Repair & Maintenance of centralized HVAC system

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

Name of the participant	Title of the event	Organizer	Date	Place
D. Chowdhury and C. K. Mahmud	Training Course on Radiation Protection for Radiation Workers and RCOs of BAEC, Medical Facilities & Industries	BAEC	05-09 Aug. 2018	AERE, Savar
	Training Course on Basic Nuclear Orientation Course	BAEC	09 Sept. -01 Nov. 2018	AERE, Savar
Dr. M. F. Waheed and M. J. Uddin	Regional Training Course on the Preparation and Quality of Therapeutic Radiolabelled Antibodies	IAEA	05-09 Nov. 2018	Indonesia
S. M. M. Mouna	Nuclear and Radiological Emergency Preparedness Course at BAEC-2018	BAEC	25 Nov. -06 Dec, 2018	AERE, Savar
Dr. R. Akhter, M. M. Rahman, D. Chowdhury and C. K. Mahmud	KOICA Workshop on Nuclear Medicine & Remote Seminar of Nuclear Science.	KOICA	09-12 Dec. 2018	NINMAS, Dhaka
Dr. M. F. Waheed	7th Workshop on Signatures of Man-Made Isotope Production (WOSMIP-7)	CTBTO	03-07 Dec. 2018	Malaysia

Name of the participant	Title of the event	Organizer	Date	Place
Dr. M. M. Rahman and Dr. M. F. Waheed	Scientific Visit regarding Establishment of Research Reactor and Radioisotope Production & other Experimental Facilities	KAERI	18-22 Feb. 2018	South Korea
Dr. M. F. Waheed, M. R. Ali, M. M. Rahman, D. Chowdhury and S. M. M. Mouna	24th National Conference of Society of Nuclear Medicine, Bangladesh	BAEC	22 Mar. 2018	Sonargaon, Dhakla
Dr. M. M. Rahman, Dr. M. A. Hossain, Dr. M. F. Waheed, Dr. R. Akhter, M. R. Ali, M. M. Rahman, D. Chowdhury, M. Ashaduzzaman and S. M. M. Mouna	Symposium on "Present Radioisotope Production (RI) Status and Future Necessary Steps to Enhance RI Production"	BAEC	27 Mar. 2018	AERE, Savar
Dr. M. M. Rahman and Dr. R. Akhter	Scientific Visit for Research Reactor, Radioisotope Production and other experimental facility at Buenes Aires and Bariloche, Argentina, 2019	BAEC	25 Apr. -03 May 2018	Argentina
Dr. M. A. Hossain	Electronic Government Procurement (e-GP) System	BAEC	31 Mar. - 04 Apr. 2019	AERE, Savar

4. Collaboration Work(s)

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

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

5. Service Rendered and Revenue Income

No. of services given to organization	Nature of service	No./Amount (GBq)	Income
21	Supply of $^{99}Mo/^{99m}Tc$ generator	942 $^{99}Mo/^{99m}Tc$ generators	8, 78, 07,588/-
16	Supply of I-131 radioisotope	746.66 GBq	68, 40,212/-
Total			9, 46, 47,800/-

6. Lecture Delivered

- Two scientists delivered lectures in the Basic Nuclear Orientation Course (BNOC)-2018 conducted by BAEC.
- The scientist of this division conducted full theoretical and practical courses of Radiopharmacy for the M. Phill course of BSMMU in 2019.

Nuclear and Radiation Chemistry Division, INST

Objective/ Introduction

The objective of Nuclear and Radiation Chemistry Division (NRCD) is modification of materials to use in the fields of health, agriculture, water treatment and biodegradable packaging material by the application of nuclear technique especially gamma ray. Moreover, this division involved to measure the water quality of research reactor, provides analytical services to different institute of BAEC/other organizations of Bangladesh and study on environmental pollution of different matrix.

Activities

1. Research and Development Work(s)

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

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

Hydrogels from polyvinylpyrrolidone(PVA), polyvinylalhohol (PVA) networks grafted with acrylic acid(AAc) was prepared by gamma radiation at 3kGy, 7kGy,10kGy from Co-60 gamma source. Concentrations of PVA,PVP (40:60 ratio) were kept constant and acrylic acid concentrations were varied from 0%-3% wt. Properties such as gel fraction, swelling ratio were investigated. It was observed that the gel fraction of blend hydrogel increases with increased amount of radiation dose and acrylic acid in the aqueous mixture of PVA PVP and acrylic acid. The lowest gel fraction was found to be ~ 61.70371 %for the gel prepared by 3 kGy of gamma radition with 1 % acrylic acid content and highest (~95.51088%) was for 10kGy irradiated gel with 3 % acrylic acid content. Swelling ratio of the hydrogels decreased with the increase in acrylic acid concentration and radiation dose.

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

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

Hydrogels from polyvinylpyrrolidone (PVP), polyvinylalcohol (PVA) networks grafted with (AAc) acrylic acid was prepared by gamma radiation. Concentrations of PVA, PVP (40:60 ratio) were kept constant and acrylic acid concentrations were varied from 0%-3% wt. The prepared hydrogels were used to remove the methylene blue dye from aqueous solution. The result indicated that dye adsorption capacity increased with increasing the acrylic acid concentration and with 3% AAc maximum dye adsorption capacity achieved. PVA/PVP blend hydrogel with 3% AAc, the dye adsorption capacity is 8.2773mg/gm. The concentration effect of MB dye on our prepared hydrogel was examined by fitting several isotherm model like Langmuir, Freundlich. It was found that Langmuir isotherm (monolayer adsoption, R^2 is 0.9243) is the best fit of experimental data than the Freundlich model(multi layer adsorption, R^2 is 0.8867).

1.3 Synthesis of Carboxymethyl Cellulose/N, N-dimethyl acrylamide based hydrogel: characterization and study of urea fertilizer slow release

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

Carboxymethyl celluse (CMC)/*N*,*N*-dimethyl acrylamide (DMAm) hydrogel was synthesized from aqueous solution of carboxymethylcelluse(CMC) and *N*,*N*-dimethylacrylamide (DMAm) by using 15kGy gamma radiation at room temperature with variation of DMAm concentration from 7%-11%.It is observed that the gel fraction of blend hydrogel increases with increased amount of DMAm that varies from 94.59% to 97.73% and the swelling ratio decreased with increasing wt percent (7% 9% and 11%) of DMAm that varies from 6452.38754 to 3852.7659.The optimum synthesis composition of 1%CMC+7%DMAm+5%Urea with a irradiation dose of 15kGy was selected for urea release study. Slow release behaviour was investigated using Urea fertilizer. The fertilizer release is reported based on the fertilizer concentrations as a function of time by using urea fertilizer. The concentration of Urea in releasing media increased slowly with time. The obtained results recommend that the prepared hydrogel could be used as medium for urea slow release.

1.4 Synthesis and characterization of pH and temperature sensitive hydrogel based on PVP, Acrylic acid AAc and N-Isopropyl acrylamide by gamma radiation

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

A series of PVP-AAc-NIPAAm based hydrogels were prepared by applying 25kGy gamma radiation and their different parameters like gel fraction and swelling ratio were investigated. It was observed that the gel fraction of hydrogel varies from ~ 97.15% to ~ 97.86% for increased percentage of NIPAAm (0.5% to 1%) in feed solution at the radiation dose of 25 kGy It was also noticed that the swelling ratio decreases with increasing NIPAAm content and the maximum swelling was obtained at percentage of PVP/AAc/NIPAAm (5/1/0.5).From the p^H observation we found that there is a significant variation in the degree of swelling at different pH values.From the temperature effect we got that at temperatures between 20ºC and 35ºC, swelling of the hydrogel was decreased with increase of temperature.

1.5 Preparation of a novel polymer adsorbent hydrogel from acrylic acid and chitosan for adsorption of Lead (II) & Copper (II) ions from wastewater

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

Environmental pollution due to heavy metal contamination is a major environmental concern. A fully biodegradable and reusable adsorbent hydrogel for removal of heavy metal ions has been developed. The hydrogel has been prepared from acrylic acid and chitosan using irradiation method. The adsorbent has been characterized using FTIR. Uptake of Copper (II) and Lead(II) at different contact times, pH, and metal ion concentrations has been investigated by batch method using Atomic Absorption Spectroscopy (AAS). Kinetic adsorption data has been studied using pseudo-first-order and pseudo-second-order equations. Experimental metal adsorption data fitted with the Langmuir isotherm model. The maximum adsorption capacity of the hydrogel was found to be 192 mg/g and 171 mg/g for Lead(II) and Copper(II) respectively from Langmuir isotherm model. Reuse and desorption of the hydrogel were also successful. The adsorbent can be used to adsorb Cu(II) and Pb(II) by column method with high removal efficiency. The data indicated the designed hydrogel was environment-friendly, regenerative, and can be used effectively for removal of toxic heavy metal cations from wastewater for a sustainable environment.

1.6 Methylene blue removal using acrylic acid and sodium styrene sulfonate grafted non-woven PE fabric

N. Rahman, N. C. Dafader, S. Shahnaz, A. R. Miah and M. J. Hossain

Environmental pollution caused by textile dyeing effluents is a major concern and treatment of dye effluents before their discharge into the environment is essential. In present study acrylic acid and sodium styrene sulfonate grafted non-woven PE fabric were prepared by the application of gamma rays from Co-60 source at room temperature. The new absorbent prepared was used for absorption of methylene blue (MB) dye. Dye absorption capacity of the absorbent was studied at different contact time, pH, and initial concentration of MB solution. Dye absorption of the absorbent reaches equilibrium value after 24 hours standing time. The absorption capacity was found highest at pH 4.38 and initial dye concentration 1000 ppm. Kinetics and isotherm of MB adsorption by the adsorbent were studied. Experimental data fitted well with pseudo 2^{nd} order kinetic model and Langmuir isotherm model. The monolayer saturation adsorption capacity obtained from Langmuir isotherm model is 250 mg/g of the adsorbent. Desorption and reuse of the absorbent was also successful. The results indicate that the acrylic acid and sodium styrene sulfonate grafted PE absorbent can be used for removal of cationic dye from industrial waste water.

1.7 Modification of mechanical and thermal properties of chitosan-PVA blend films using radiation technique

N. Rahman, N. C. Dafader, S. Shahnaz and A. R. Miah

In this study casting method is used to prepare different composition of chitosan-PVA blend films (thickness 0.16 mm). Optimum composition (chitosan: PVA = 1: 4) of the blend film was selected based on mechanical properties. The tensile strength (TS) and elongation at break (Eb) of the film at this composition was 24 MPa and 20 % respectively. The chitosan-PVA films were modified with monomer, methyl methacrylate (MMA**)** using gamma radiation. Monomer concentration was varied from 1-7 %, soaking time was varied from 10-30 min and radiation dose were varied from 10 kGy-40 kGy. Mechanical properties of the modified films were investigated. The best performance was observed for the chitosan-PVA films soaked in 3% monomer solution for 20 min soaking time and irradiated by 30 kGy radiation doses. The TS and Eb found under this condition was 36 MPa and 34 % respectively. Water uptake of the films was studied. Thermal properties of films were characterized by thermo gravimetric analysis (TGA) and dynamic mechanical analysis (DMA). The molecular interaction and morphological features of the films were investigated using Fourier Transform Infrared Spectroscopy (FTIR) and Scanning Electron Microscopy (SEM).

1.8 Assessment of toxic elements in effluents of different dyeing industries around Dhaka export processing zone (DEPZ), Savar, Dhaka

F. T. Ahmed, M. S. Rahman, G. Ara, M. A. Ali and M. F. Alam

It is an eminent fact that the effluents released from the industries and environmental dilapidation go hand in hand. Dyes are primarily used in the production of consumer products and are commonly found in paints,

textiles, printing inks, paper, and plastics - adding to the color and patterns of materials. Thus effluents from the dyeing industries can be considered as a major source of environmental pollution in the DEPZ area, Savar, Dhaka. Six (6) treated wastewater were collected from six dyeing industries and these effluents were analyzed for toxic elements like Fe, Cu, Ni, Pb, Cd and Cr. Samples were assessed for heavy metals by Flame Atomic Absorption Spectrophotometer (FAAS) after successive acid digestion. The concentration of Fe, Cu, Ni, Pb, Cd and Cr were found in a range of 0.760 - 2.728, 0.008 - 0.060, 0.174 - 0.280, 0.022 - 0.120, BDL - 0.009 and 0.052 - 0.103 mg/L respectively. These results were compared by WHO (2004) and USEPA (2011) and it was seen that the quantity of Fe and Ni in all samples were found much higher than the WHO and USEPA standard values for treated wastewater and for Cd (in three samples), Cr and Pb in all samples were greater than WHO standards. So, routine monitoring of dyeing industries is therefore highly recommended to prevent the risk of contamination to the receiving watershed which many communities depends as source for domestic water.

1.9 Detection and evaluation of some heavy metal contaminants in some commercially available natural health care products in Bangladesh and their carcinogenic risk assessment

F. T. Ahmed, M. F. Alam, A. K. M. Mahmudullah, M. S. Islam, M. H. Islam and N. C. Dafader

Human beings are encouraged to take herbal medicines to recover from diseases, as they are considered in general to have no side effect. But in recent years there is a growing concern on heavy metals in consumer products due to their potential human health risks and environmental effects. The purpose of this study was to determine the heavy metal constituents in the natural health products. Fourteen (14) medicine samples were collected from the local markets of Savar, Bangladesh in the form of tablet and capsules. In this research work, the quantity of cadmium (Cd), chromium (Cr), copper (Cu), lead (Pb) and zinc (Zn) were assessed in these samples using Atomic Absorption Spectrophotometer (AAS) after acid digestion. The concentration of Cd, Cr, Cu, Pb and Zn were found in the range of 0.18 - 1.03 μg/g, 14.98 - 35.18 μg/g, 0.37 - 6.24 μg/g, BDL – 3.06 μg/g and 1.89 - 52.37 μg/g respectively. These results were compared by the WHO, USFDA, Canada, China, Singapore national standards and it was seen that in most of the samples; concentration of Cd and Cr exceeds the standard value which were very alarming. The carcinogenic risk was calculated for Cr, Cd and Pb and it was higher than the maximum limit (10^{-4} mg/kg/d) for most of the samples of Cr and Cd. So, high cautions should be taken for the use of these medicinal products.

1.10 Bioaccumulation of heavy metals in tannery effluents of Hazaribag, Dhaka using bacteria and aquatic plants

F. T. Ahmed, K. Khatun, M. F. Alam, S. Shahnaz, G. Ara, M. S. Rahman and N.C. Dafader

The study was conducted to evaluate the potentiality of water lettuce, water hyacinth and bacteria (Agrobacterium tumefaciens and Bacillus cereus) in the removal of pollutants from tannery effluents. Here involved laboratory experiments of 15 days using different treatments where efficiency was tested by analyzing the heavy metals (Cr, Ni, Zn, Cu and Mn) concentrations using Atomic Absorption Spectrophotometer (AAS) of collected effluents from Hazaribag Tannery Area in Dhaka. All the parameters showed considerable rate of reduction for different treatments. Water lettuce effectively removed approximately 86.12% of Cr, 91.87% of Ni, 88.71% of Zn, 86.60% of Cu and 81.90% of Mn. Water hyacinth effectively removed heavy metals approximately 83.95% of Cr, 90.28% of Ni, 88.26% of Zn, 81.57% of Cu and 78.59% of Mn. The bacteria's (Agrobacterium tumefaciens) effectively removed approximately 83.07% of Cr, 88.57% of Ni, 88.27% of Zn, 79.96% of Cu and 79.09% of Mn. and Bacillus cereus effectively removed approximately 85.61% of Cr, 90% of Ni, 89.35% of Zn, 82.93% of Cu and 80.47% of Mn. Combined treatment with both bacteria effectively removed approximately 80.49% of Cr, 87.14% of Ni, 86.59% of Zn, 79.93% of Cu and 75.89% of Mn at the end of 15 days. The study concluded that both of plants and bacteria used in the experiment have great potential for the removal of pollutants including heavy metals from tannery effluents and in some cases the combined treatments were more effective than the single treatment.

2. Manpower Development and Training Program

Title of the event	Date	Place	No. of participant
Group Training/Fellowship on Sampling and Analysis of Stable Isotope and Trace Elements.	24 Jun. – 07 Jul. 2018	Department of Chemistry, Otago University, Dunedin, New Zealand	01
Training Course on Radiation Protection for Radiation Workers and RCOs of BAEC, Medical Facilities & Industries	5-9Aug. 2018	BAEC	01
69th Training programme of NITUB on "The Use, Maintenance and Trouble-shooting of UV-Visible and IR Spectrophotometer".	08-13 Sept. 2018	Bangladesh Council of Scientific and Industrial Research (BCSIR), Dr. Qudrat-I-Khuda Road, Dhanmondi, Dhaka-1205.	01
Training Course on "Awareness on Nuclear Cyber Security"	12-13 Nov. 2018	ICS, AERE, Savar, Dhaka	01
RCA/UNOSSC Regional Training Course on Advanced Knowledge and On-site Training on EB Applications for Advanced Materials	10-14 Jun. 2019	Republic of Korea	02

3. Seminar/Conference/Workshop/Meeting attended

Name of the participants	Title of the event	Organizer	Date	Place
Dr. N. Rahman	Technical Meeting on Basic Radiation Chemistry for Polymer Modification	IAEA	10 -14 Sept. 2018	Lodz University of Technology, Poland
	First Project Coordination Meeting of IAEA Technical Cooperation Project RAS1023	IAEA	18-22 Feb. 2019	Malaysia
Dr. N. Rahman, M. F. Alam and F. T. Ahmed	Bangladesh Chemical Congress 2018	Bangladesh Chemical Society	17-19 Oct. 2018	Dhaka
Dr. S. Sultana	The FNCA 2018 Workshop on Radiation Processing and Polymer Modification for Agricultural, Environmental and Medical Applications	FNCA	08-12 Oct. 2018	Kazakhstan
Dr. S. Sultana and F. T. Ahmed	25th Anniversary Celebrating by OWSD (Organization for Women in Science for the Developing World) in Bangladesh"	OWSD-BD	10 Nov. 2018	Dhaka
Dr. N. Rahman and F. T. Ahmed	National Conference on physics-2019	Bangladesh Physical Society	7-9 Feb. 2019	Dhaka

4. Collaboration Work(s)/MoU

R&D Project of Ministry of Science and Technology

Duration: July 2018 - June 2019

Title of the Project: Heavy Metals Analysis and Health Risk Assessment of Different Energy Drinks Available in Bangladesh

Project Director: Farah Tasneem Ahmed, Scientific Officer, NRCD, INST, AERE

Result Obtained: Thirteen (13) energy drinks samples were analyzed for various physico-chemical parameters like pH, EC, TDS, Total Acidity and Heavy metal concentration. In this research the pH of these beverages were found in highly acidic and thus is very damaging for our dental health. Heavy metals like Fe, Mn, Cu, Zn, Ni, Cd and Cr were measured by Atomic Absorption Spectrophotometer and it was found that Fe, Cd and Ni concentration in all the energy drinks samples were much higher than WHO standard value. Cr concentrations in most of the samples were above the standards as well. Also, non-carcinogenic and carcinogenic risks of these metals in energy drinks were calculated and for samples for long term consumption can cause great harm to the health.

5. Service Rendered and Revenue Income

Name of service	No./quantity of sample	Income
Water Sample Analysis of Food Technology Division, IFRB, AERE	Water sample - 19 (Eight heavy metals)	-
Industrial Effluent Analysis	Effluent - 02 (Cr)	3000/-
Groundwater Sample Analysis of Costal Area Institute of Nuclear Minerals (INM), AERE	Water sample - 15 (03 physical and 17 chemical parameters which included 13 heavy metals and five anions)	-
Electrical Conductivity (EC) Measurement of Honey Samples of Food Technology Division, IFRB, AERE	Honey samples - 23	-
Groundwater Sample Analysis of Isotope Hydrology Division, INST, AERE	Water Sample – 23 (Na, K, Ca and Mg)	-
Gellan Solution Analysis	Gellan sample - 1 (Na, K, Ca and Mg)	6000/-

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/Program(s)

1. Research and Development Work(s)

1.1 Calibration of therapy level ionization chamber at ^{60}Co teletherapy beam used for radiation therapy

M. A. Reza, M. R. Islam, M. S. Rahman M. Shamsuzzaman, M. R. Rahman and H. R. Khan

The accuracy and traceability of absorbed dose to water measurement of radiotherapy beam is a critical issue to achieve the curative outcome of cancer patients. The current dosimetry protocols for radiotherapy beams TRS-398, TG-51 and DIN-6800-2 are based on the calibration factor of ionization chamber in terms of

absorbed dose to water for ^{60}Co beam. The accuracy of the calibration factor of ionization chamber as well as output of radiotherapy beam is the primary requirements precisional dose deliver to the tumor which is the QA part of radiotherapy dosimetry. In the present study, we have calibrated 9 different ionization chambers (8 thimbles and 1 parallel plate) of various active volumes for ^{60}Co beam against reference standard NE2571 and compared with manufacture`s values. The percentage depth dose (PDD) and Output Factors (OF) of two cobalt units were measured with standard calibration system by following IAEA dosimetry protocol TRS-398 and compare with 6 MV photon beam from medical linear accelerator. The traceability of the dosimetry was verified by the participation of postal dose IAEA/WHO intercomparision program. The aim of the participation was to investigate uncertainties involved in the calibration of Ionization Chamber (IC) and absorbed dose measurement. The percentage of deviation relative to IAEA mean dose was found to be-0.2% (traceable limit ±5%), which shows an excellent agreement of calibration of beam as well as ionization chamber with international standard. The deviation of $N_{D,W}$ factors of ionization chambers between the measured and manufacturer`s values were found within 0.07-2.81% with an uncertainty of ±1.5% (k=1).

1.2 Experimental investigation of gamma-ray attenuation capacity of some local shielding materials of Bangladesh in the energy range 33-662 keV

M. Shamsuzzaman, A. F. M. M. Rahman, M. S. Rahman D. Paul, K. Uddin and S. R. Chakraborty

Shielding materials are required for the radiation protection in the places where high energy photons and neutrons are used for various medical and industrial purposes. In Bangladesh local bricks made of clay-sand, ceramic, ilmenite-magnetite and mosaic blocks are generally used as building material. The Shielding potentials of these materials are estimated in this study. In this perspective, the linear and mass attenuation coefficients of these types of materials have been measured using a 225 kV X-ray machine and a cesium (^{137}Cs) calibrator. The present study is undertaken with the X-ray and gamma beams to check the shielding capacity of the aforesaid materials in the energy range of 33-662 keV.

1.3 Dosimetric comparison of deep inspiration breathe hold and free breathing technique in stereotactic body radiotherapy for localized lung tumor using Flattening Filter Free bream

K. R. Mani, M. A. Bhuiyan, M. M. Alam, S. Ahmed, M. A. Sumon, A. K. Sengupta, S. Rahman and S. M. A. Islam

To compare the dosimetric advantage of stereotactic body radiotherapy (SBRT) for localized lung tumor between deep inspiration breath hold technique and free breathing technique.Ten previously treated lung tumor patients were considered in this dosimetric study. All the ten patients underwent CT simulation using 4D-CT free breathing (FB) and deep inspiration breath hold (DIBH) techniques. Plans were created using three coplanar full modulated are using 6MV flattening filter free (FFF) bream with a dose rate of 1400 MU/min. Same dose constraints for the target and the critical structures for a particular patient were used during the plan optimization process in DIBH and FB datasets. We intended to deliver 50 Gy in 5 fractions for all the patients. For standardization, all the plans were normalized at target mean of the planning target volume (PTV). Doses to the critical structures and targets were records from the dose volume histogram for evaluation.The mean right and left lung volumes were inflated by 1.55 and 1.60 times in DIBH scans compared to the FB scans. The mean internal target volume (ITV) increased in the FB datasets by 1.45 times compared to the DIBH data sets. The mean dose followed by standard deviation of ipsilateral lung for DIBH-SBRT and FB-SBRT planswere 7.48± 3.57 (Gy) and 10.23 ± 4.58 (Gy) respectively, with a mean reduction of 36.84% in DIBH-SBRT plans. Significant dose reduction in ipsilateral lung due to the lung inflation and target motion restriction in DIBH-SBRT plans were observed compare to FB-SBRT. DIBH-SBRT plans demonstrate superior dose reduction to the normal tissues and other critical structures.

1.4 Harnessing the thermoluminescence of Ge-doped silica flat-fibres for medical dosimetry

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

Study has been made of key thermoluminescence (TL) properties of Ge-doped silica flat-fibre, including TL glow curves, dose-rate dependency and reproducibility, the fibres being photon irradiated over the dose range 0.5 to8 Gy, use being made of a medical linear accelerator (LINAC) operated at either 6 or 10 MV. Percentage depth doses (PDD) were also studied; comparison being made of fibre-measured PDD values against those obtained using an ionization chamber and standard TLD-100 and TLD-700 chips. The flat-fibre samples displayed a single prominent TL glow curve dosimetry peak at 249 ºc, the structure of this remaining

unchanged during repeat cycles of annealing and irradiation at different doses, the TL responses of the samples also remained practically constant in use of five different dose-rates in the range 100 MU/min to 500 MU/min. The effective atomic number (Z_{eff}) of the flat-fibre was calculated to be 13.37, greater than soft tissue (7.42) but within the range of values for human bone (11.6-13.8). Using the 6 MV photon beam, PDD studies yielded a dmax of 1.5 cm, consistent with the value attained using the ionization chamber and the standard TLD chips. At 2 cm depth, the optical fibre samples showed good agreement to within-4%, 1.3% and 4% respectively with measurements made in use of the ionization chamber, standard TLD-100 chips and TLD-700 chips. The study represents part of an overall plan towards development of silica fibre-based dosimeters for radiotherapy and diagnostic radiology applications.

1.5 Radionuclide adsorption performance in cement and soil medium for safety issue of radiactive waste disposal facility

M. Shamsuzzaman, A. Biswas, M. M. Bhuiyan, M. A. Haydar, D. Paul, M. J. Dewan and M. S. Islam

Radionuclide migration from a disposal facility is one of the most crucial factors for protecting man and environment. To ensure safety of a disposal facility, radionuclide migration or adsorption behavior is a key issue in operational and post operational phase. In this perspective, laboratory based column experiments was carried out to investigate the adsorption behavior of radionuclide on the cement and soil mediums. Present experiments simulate the migration behavior of radionuclide through the cement and soil barrier into the environment if the waste packs inside a disposal site encounter rain infiltration. In this study, some stimulant cement chunk was produced with awater-cement ratio of 0.50 each, and soil samples were prepared with various grain sizes from 90 μm to 2 mm. In this study, adsorption and hence migration behavior of solid spent resin was verified experimentally. In addition, adsorption of two radio nuclides, namely ^{60}Co and ^{137}Cs was investigated as liquid waste by using the gamma spectrometry analysis. The highest activity distribution of ^{60}Co at 1173.2 keV and ^{137}Cs was found in concrete medium 53.49%, and 46.82 in the soil medium, respectively. Thus, locally prepared multiple barriers of cement and soil medium could reasonably be suitable for liquid waste immobilization.

1.6 Elevated concentrations of naturally occurring radionuclides in heavy mineral-rich beach sands of langkawi Island, Malaysia

M. U. Khandaker, K. Asaduzzaman and A. F. B. Sulaiman, D. A. Bradley and M. O. Isinkaye

Study is made of the radioactivity in the beach sends of Langkawi island, a well-known tourist destination. Investigation is made of the relative presence of the naturally occurring radionuclide ^{40}K and the natural-series indicator radionuclides ^{226}Ra and ^{232}Th, the gamma radiation exposure also being estimated. Sample quantities of black and white sand were collected for gamma ray spectrometry, yielding activity concentration in black sands of ^{226}Ra, ^{232}Th and ^{40}K from 451 ± 9 to 2411 ± 65 Bq kg^{-1} (mean of 1478 Bq kg^{-1}), 232 ± 4 to 1272 ± 0.5 Bq kg^{-1} (mean of 718 Bq kg^{-1}), and 61 ± 6 to 136 ± 7 Bq kg^{-1} (mean of 103 Bq kg^{-1}), respectively. Conversely, in white sand the respective values for ^{226}Ra, ^{232}Th were appreciably lower., at 8.3 ± 0.5 to 13.7 ± 1.4 Bq kg^{-1} (mean of 9.8 Bq kg^{-1}) and 4.5 ± 0.7 to 9.4 ± 1.0 Bq kg^{-1} (mean of 5.9 Bq kg^{-1}); ^{40}K activities differed insubstantially from that in black sands, at 85 ± 4 to 133 ± 7 Bq kg^{-1} with a mean of 102 Bq kg^{-1}. The mean activity concentrations of ^{226}Ra, ^{232}Th in black sands are comparable with that of high background areas elsewhere in the world. The heavy minerals content gives rise to elevated ^{226}Ra, ^{232}Th activity concentrations in all of black sand sample. Evaluation of the various radiological risk parameters points to values which in some cases could be in excess of recommendations providing for safe living and working. Statistical analysis examines correlations between the origins of the radionuclides, also identifying and classifying the radiological parameters. Present results may help to from an interest in rare-earth resources for the electronics industry, power generator and the viability of nuclear fuels cycle resources.

1.7 A Study of measurement of relative dose with various chamber for small field dosimetry of 6 MV photon beam

S. Purohit, S. M. E. Kabir, M. S. Rahman, M. K. A. Patwary, A. K. M. M. H. Meaze, I. Jahan, A. A. Mamun and D. Paul

The new technologies intensity modulated radio therapy (IMRT), image guided radio therapy (IGRT) and stereotactic radio therapy (SRT) are the improved radiotherapy techniques where proper commissioning of clinic is necessary to save patient's healthy cells from adverse effect of radiation. The IEAE dosimetry

protocol TRS-398 has been used to measure the absolute dose at 10 cm × 10 cm with CC13 (ionization) chamber. Later, the CC13 chamber was cross calibrated with CC01 (ionization) and Razor (diode) chamber respectively for the measurement of dose in small fields. According Daisy Chaining Factor method, dose was measured for CC13 (ionization) to Razor (diode). On the other hand, the reference dose for small field was also measured for different field size (s) by applying newly proposed formalism (R. Alfonso et al. 2008) using CC13 (ionization) chamber and fitted with 4^{th} order polynomial fitting function where R^2 =1. The variation of dose was observed as around ±4% by CC01 (ionization) and Razor (diode) chambers for field sizes 1 cm × 1 cm field at reference condition in the cross-calibration technique. The sources uncertainties were calculated as per IAEA guidelines for both Type-A and Type-B. The combined standard uncertainty lies within ±1.51%.

1.8 Investigation on radioactivity in soil and sediment samples of Rupsha river, Khulna, Bangladesh and their associated radiological hazards

J. Sultana, T. Islam, M. A. Haydar, M. I. Ali and D. Paul

The radionuclide contents and their activity concentrations in soil and sediment samples have been collected from in and around the Rupsha River, Khulna, Bangladesh. They have been determined by using a High Resolution Germanium detector (HPGe) during April to June 2015. A total of 20 samples of two categories were collected and analyzed. The activity concentrations of 226Ra, 232Th and 40K in the soil samples of the Rupsha river side area have been found with an average value of 50.16 ± 7.20 $Bqkg^{-1}$, 77.23 ± 7.43 $Bqkg^{-1}$ and 864.63 ± 101.69 $Bqkg^{-1}$ respectively. For sediment samples the activity concentrations of the corresponding radionuclides have been found with an average value of 50.46 ± 6.20 $Bqkg^{-1}$, 73.99 ± 7.56 $Bqkg^{-1}$ and 881.49 ± 100.25 $Bqkg^{-1}$ respectively. The results for both the soil and sediment samples obtained for the corresponding nuclides are slightly higher than the worldwide average value of 35, 30 and 400 $Bqkg^{-1}$. The average absorbed dose rates, radium equivalent activity, external hazard index due to these radionuclides in soil and sediment samples have a1so been calculated. The values are less than unity in all the samples that indicate the non-hazardous nature of the samples and there is no possibility of immediate health effect on the workers, public and environment.

1.9 Determination of beam quality of high energy photons in non-standard reference condition using linear fit method

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

Tissue Phantom Ratio ($TPR_{20\ .10}$) for the field size of (10 ×10) cm^2 became the quality index for most of the code of practice, whereas percentage depth dose (%dd) $(10)_x$ is the beam quality index for the TG-51 code of practice. In the present work, we have proposed a simple linear fit method to determine the beam quality index under non-reference conditions (i.e. radiotherapy treatment machines which cannot simulate a reference condition of 10 ×10) cm^2 field size) that validated using BJR supplement 25 data. $TPR_{20\ .10}$ versus square field sizes from (4 × 4) cm^2 to (12 × 12) cm^2 is a linear straight line. By using the data given in the British Journal of Radiology (BJR) Supplement-25, we have plotted a straight line graph for lower field sizes and obtained the beam quality index of the reference field size 10 ×10 cm^2 . The calculated $TPR_{20.10}$ by the linear fit method from present studies were also compared and analyzed with Palmans method for the photon beam energy from 4 MV to 25 MV.

2. Manpower Development and Training Program

Title of the event	Date	Place	No of participant
Training Course on "Application of Radiotherapy in Cancer Treatment" delivered by Kanij Fatema, SO, HPRWMU, INST.	12 Aug. 2018	SSDL, INST, AERE	23
Training Course on "Introduction to Learning-How Adults Learn" delivered by Shampa Paul, SE, HPRWMU, INST.	16 Aug. 2018	SSDL, INST, AERE	24
Training Course on "Sitting Procedure for Near Surface Disposal Facility" delivered by Siddha Moutoshi Shome, SG, HPRWMU, INST.	29 Aug. 2018	SSDL, INST, AERE	21
Training Course on "Scientific Opinion on the Standards and Regulatoins of Irradiated food" delivered by Md. Habibur	06 Sept. 2018	SSDL, INST, AERE	23

Title of the event	Date	Place	No of participant
Rahman, EO, HPRWMU, INST.			
Training Course on "Radiation Safety in Irradiation Facility" delivered by Dr. Debasish Paul, CSO, HPRWMU, INST.	16 Sept. 2018	SSDL, INST, AERE	21
Training Course on "Country--wide Background Radiation Mapping: A Systematic Approach" delivered by Dr. Md. Idris Ali, CSO, HPRWMU, INST.	25 Sept. 2018	SSDL, INST, AERE	21
Training Course on "Analytic Hierarchy Process(AHP)" delivered by Md. Abu Hayder, SO, HPRWMU, INST.	07 Oct. 2018	SSDL, INST, AERE	23
Training Course on "Basic Concept of Radiation Shielding" delivered by Dr. Debasish Paul, CSO, HPRWMU, INST.	15 Oct. 2018	SSDL, INST, AERE	22
Training Course on "The Effect of Different Dopant Concentration of Tailor-Made Silica Fibers in Radiotherapy Dosimetry" delivered by Dr. Mahfuza Begum, PSO, HPRWMU, INST.	23 Oct. 2018	SSDL, INST, AERE	17
Training Course on "Measurement of Radionuclide's in the Environment under Nuclear Disaster" delivered by Dr. Mosharraf Hossain Bhuiyan , PSO, HPRWMU, INST.	11 Nov. 2018	SSDL, INST, AERE	21
Training Course on "A Brief Discussion on Radiation Detection Instrument" by Tanjim Siddiqua, SSO, HPRWMU, INST.	22 Nov. 2018	SSDL, INST, AERE	22
Training Course on "Transport Regulation of Radioactive Material Based on SSR-6(2012) Recommendations" by Dr. Md. Shamsuzzaman, PSO, HPRWMU.	29 Nov. 2018	SSDL, INST, AERE	17
Training Course on "Basic Concept of Ionizing Radiation" delivered by Dr. Md. Moinul Islam, CSO, HPRWMU, INST.	13 Dec. 2018	SSDL, INST, AERE	18
Training Course on "Internal Dose Assessment" delivered by Dr. Md. Moinul Islam, CSO, HPRWMU.	18 Dec. 2018	SSDL, INST, AERE	13
Training Course on "Radiation Worker and Patient Safety" delivered by Dr. Debasish Paul, CSO, HPRWMU, INST.	03 Jan. 2019	SSDL, INST, AERE	22
Training Course on "Radiation and its Detection" delivered by Dr. Khandoker Asaduzzaman, PSO, HPRWMU, INST.	10 Jan. 2019	SSDL, INST, AERE	21
Training Course on "Medical Radiation Dosimetry" delivered by Dr. Md. Shakilur Rahman, CSO, HPRWMU, INST.	27 Jan. 2019	SSDL, INST, AERE	20
Training Course on "Introduction to Nuclear and Radiological Emergency Preparedness and Radiation Safety in Emergency Situation" delivered by Shampa Paul, SE, HPRWMU, INST.	14 Feb. 2019	SSDL, INST, AERE	17
Training Course on "Radioactive Waste Management in Bangladesh: Recent Activities and Future Plan" delivered by Dr. Md. Idris Ali, CSO, HPRWMU, INST.	20 Feb. 2019	SSDL, INST, AERE	16
Training Course on "Duties of Radiation Control Officer(RCO)" delivered by Dr. Mosharraf Hossain Bhuiyan , PSO, HPRWMU, INST.	27 Feb. 2019	SSDL, INST, AERE	20
Training Course on "Security of Nuclear Material in Transport" delivered by Dr. Md. Shamsuzzaman, PSO, HPRWMU, INST.	07 Feb. 2019	SSDL, INST, AERE	21
Training Course on "Measurement of radiation caused by radioactive substances discharged" delivered by Dr. KhandokerAsaduzzaman, PSO, HPRWMU, INST.	13 Mar. 2019	SSDL, INST, AERE	21
Training Course on "External radiation control technique during radiation protection service" delivered by Bidhan	28 Mar. 2019	SSDL, INST, AERE	20

Title of the event	Date	Place	No of participant
Chandra Sutradhar, EO, HPRWMU, INST.			
Training Course on "Natural Terrestrial Radiation" delivered by TanjimSiddiqua, SSO, HPRWMU, INST.	18 Apr. 2019	SSDL, INST, AERE	19
Training Course on "Radiation Protection and Safety Assessment in Brachytherapy Facility" delivered by Dr. Mahfuza Begum, PSO, HPRWMU, INST.	23 Apr. 2019	SSDL, INST, AERE	20
Training Course on "Radiological Safety Assessment during Production and Transportation of I-131 and Tc-99^m Radioisotopes" delivered by Md. Habibur Rahman, EO, HPRWMU.	30 Apr. 2019	SSDL, INST, AERE	19
Training Course on "Nuclear/Radiological Safety Culture Analysis" delivered by Shampa Paul, SE, HPRWMU, INST.	14 May 2019	SSDL, INST, AERE	20
Training Course on "Uncertainty in Counting Efficiency of high Purity Germanium Detector" delivered by Md. Abu Hayder, SSO, HPRWMU.	22 May 2019	SSDL, INST, AERE	23
Training Course on "Current status of Radioactive Waste Management(RWM) activities at CWPSF" delivered by Bidhan Chandra Sutradhar, EO, HPRWMU, INST.	30 May 2019	SSDL, INST, AERE	21
Training Course on "Preparedness, Response and Consequence Mitigation Activities in Nuclear and Radiological Emergency" delivered by Dr. Md. Idris Ali, CSO, HPRWMU, INST.	13 Jun. 2019	SSDL, INST, AERE	19

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

Name of the participant	Title of the event	Organizer	Date	Place
Dr. D. Paul Dr. S. Rahman Dr. M. H. Bhuyan Dr. M. Begum Dr. M. Shamsuzzaman	National Conference on physics	BPS	07-09 Feb. 2019	Department of Physics, DU

4. Collaboration Work(s)

SNT Project (Science and Technology; Under special allocation from M/O Science and Technology) for financial year 2018-2019.23 Phy's: Title -"Assessment of Natural level of Radioactivity in Staple Foodstuffs to Generate National Baseline Data". (Principal Investigator – Dr. Khandoker Asaduzzaman, CSO; Associate Investigator 1-Dr. Mahfuza Begum, PSO; Associate Investigator 2- Kanij Ratema, SSO).

5. Others

Numbers of environmental sample analysis by HPGe Detector are 339.

6. Service Rendered and Revenue Income

No. of service given to the organization	Name of service	No. of sample	Income
8	Radiation survey	10	60,000/-
4	Interim storage	4	17,96,000/-
48	Radiation measuring devices calibration, dosimetry	108	7,26,000/-
		Total	25,82,000/-

Reactor Physics & Engineering Division, INST

Objective/Introduction

The program of the division is to conduct R&D activities using modern methods for the computational analysis of nuclear reactors, with particular emphasis on reactor physics, design and safety. Here we procure and implement computer codes related to reactor engineering and nuclear data processing with international collaboration. The ultimate objective of the division is to support the development of infrastructure for nuclear power program to meet the ever increasing demand of electricity.

Activities/Program(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. TRIGA system modeling with RELAP-5 is going on. The division also supports Nuclear Engineering study program of different local universities.

1. Research and Development Work(s)

Description: RPED is engaged in developing and transferring technology/computer codes for overall design, analysis, in-core fuel management and safety studies of nuclear reactors. The following on-going research projects are highlighted to reflect the activities of the division:

- Nuclear engineering and nuclear data processing
- Radiation shielding technology
- Neutronics analysis of nuclear reactors
- Thermal hydraulics and Safety studies of nuclear reactors

2. Manpower Development and Training Program

Title of the event	Date	Place	No. of participant
In-house training course on Frequently Asked Questions (FAQ) of Rooppur Nuclear Power Plant	07 Aug. 2018	MOST	01
Three Lectures delivered in Basic Nuclear Orientation Course (BNOC-2018, 2nd Batch)	09 Sep.-01 Nov. 2018	Training Institute, AERE	
Nuclear Cyber Security Awareness Training Program	12-13 Nov. 2018	Institute of Computer Science, AERE	01
Four Lectures delivered for Reactor Engineering Course at BAEC (RECB-7)-2019	10-28 Feb., 2019	Training Institute, AERE	

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

Name of the participant	Title of the event	Organizer	Date	Place
Dr. B. N. Hamid	The FY2018 Steering Committee Meeting	BAEC and JAEA	16 Oct. 2018.	BAEC, Dhaka
	Joint IAEA-KINS Regional Network Meeting on Regulatory Framework and Infrastructure for Nuclear Safety	IAEA-KINS	03-07 Dec. 2018	Daejeon, Korea
S. M. Shauddin	Joint ICTP IAEA 1st Course on Scientific Visit Novelties in Phenomenology of Severe Accidents in Water-Cooled Reactors (smr 3247)	IAEA	22-26 Oct., 2018	Trieste, Italy
Dr. M. S. Rana	Inspection of the Manufacturing of LTME for the construction of Rooppur Nuclear Power Plant	Russian Federation	08 Apr. - 31 Jul. 2019	Volgado, Russia

Tandem Accelerator Facilities Division, INST

Objective/Introduction

A 3 MV Tandem Accelerator was installed at the campus of Atomic Energy Research Establishment (AERE) of Bangladesh Atomic Energy Commission in Savar in 2010. The use of low-energy charged particle accelerator in nuclear research is of high significance, both with regard to fundamental nuclear investigations and to provide valuable data/information for various fields of applied sciences, to study various environmental pollution studies. Among the latter category, analytical techniques like PIXE (Particle Induced X-Ray Emission) and Rutherford Backscattering (RBS) are well established. With regard to fundamental studies, investigation of nuclear reactions using modern high quality detectors and electronics system is gaining new interests.

The main objective of this division is to keep the complex accelerator system operational and provide ion beam for doing research. The other objectives are the following:

- To train manpower in advanced nuclear technology
- To study basic nuclear phenomena
- To provide valuable data/information for various fields of applied sciences
- To study various radiological effects around a nuclear power plant
- To help students to obtain academic degrees

Activities/Program(s)

1. Research and Development Work(s)

1.1 Elemental analysis using PIXE technique

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

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

1.2 Study of (p, γ) reactions via the activation technique

For nuclear reaction studies a co operation with the Institute of Nuclear Chemistry of the Forschungszentrum Jülich has been established. A new beam line for this research has been designed and established at the +10° beam port of the Tandem Accelerator. Because of rather low energy of available protons (≤ 6 MeV) from 3 MV Tandem Accelerator, studies on (p,γ) reactions seem to be more appropriate. In the first phase the emphasis has been given on Ni and Fe. The suggested (p,γ) reaction work at Savar up to 6 MeV could be extended at Jülich to the higher energy range up to about 20 MeV. The results would then allow constructing full excitation functions. The experimental and theoretical studies on the (p,γ) reactions should lead to useful insight into mechanisms of those reactions, especially the radiative proton capture process (i.e. the (p,γ) reaction) which is rather rare. The data will be of practical use also, in particular for accelerator shielding, neutron dosimetry and radionuclide production.

2. Repair & Maintenance and Renovation Works

- High Voltage conditioning of the 3 MV Tandem Accelerator
- Maintenance of Ion source MPI CANNODE used for optical fiber communication
- Maintenance of SF6 gas used in the Accelerator tank by DILO system such as gas recovery, filling and circulating

- Fixing the problems of generator motor used in striper section inside the Accelerator tube
- Opening and re-connecting the tank and shell used in the Accelerator using special laparoscopic camera
- Fixing the problems of driver section by replacing two burnt capacitor with new two
- Test and replacement of turbo molecular pump used at low energy side of Tandem Accelerator
- Replacement of roughing pipe used in 358 Duoplasmatron ion source
- Preparation of filament and filament coating used in 358 Duoplasmatron ion source.
- Outgassing of 358 Duoplasmatron ion source
- Fixing the stepping down problem of 6 axes Gonio-meter in experimental chamber of the Accelerator
- To estimate the number of fore pump, turbo pump, and valves required to get proper vacuum for the new beam line with remote operating system

3. Manpower Development and Training Program

Title of the event	Date	Place	No, of participant
In-house training course on X-ray, Gamma-ray and Surface Barrier Detectors	26-28 Aug.2018	TAFD, INST	12
In-house training course on Amplifier, ADC and Bias Supply	3-5 Sep.2018	TAFD, INST	13
In-house training course on UPS, Crane and Comp. Air system	1-3 Oct.2018	TAFD, INST	12
In-house training course on Vacuum Pumps	1,4, 5 Nov.2018	TAFD, INST	13
In-house training course on DILO system and Sample Holder	2-4 Dec.2018	TAFD, INST	13
In-house training course on Tank, Stripper section and GVM	1-3 Jan.2019	TAFD, INST	14
In-house training course on Accelerator Tube, Driver and High Voltage generation	3-5 Feb.2019	TAFD, INST	13
In-house training course on Ion Sources	3-5 March 2019	TAFD, INST	15
In-house training course on Injector and Switching magnet, Quadrupole lenses	1-3 April 2019	TAFD, INST	13
In-house training course on Steerer, Faraday Cup, BPM	2, 5, 6 May 2019	TAFD, INST	11

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 31-12-2020

Description

A new state-of-the-art 3 MV Tandem accelerator facility has been built at INST, AERE, Savar under an annual development project (ADP) of Bangladesh Government to continue and expand the research and service work using accelerator related nuclear techniques. There is a growing demand of elemental analysis of wide variety of samples in the country. Now the machine is severely underutilized due to some problems. Under the proposed project the scientific and technical manpower will be trained for safe operation, maintenance and maximum utilization of the above nuclear facility.

There is a great demand to application of mutation breeding on crops and other economically important plants to achieve self sufficiency in food and feed production. Therefore, it is planned to design and construct new facility and perform irradiation on seeds and other plant samples for mutation studies and develop high

yielding new environment friendly, adaptive plant varieties by using the new Tandem accelerator facility. During this period two IAEA expert mission to Tandem facility and two scientific visits of our senior scientist to a advanced accelerator facility in Japan, where similar mutation research using accelerator has been performed was conducted.

Isotope Hydrology Division, INST

Objectives/ Introduction

The Isotope Hydrology Division has set its aim to apply the isotope techniques in the following areas.

- 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 $\delta^{2}H$ & $\delta^{18}O$ & radioactive ^{3}H & ^{14}C)
- Determination of groundwater parameters such as direction of groundwater flow, filtration velocity, vertical flow velocity, permeability, effective porosity and dispersion coefficient by single-well dilution technique

Activities /Program(s)

1. Research and Development Work(s)

Isotope Hydrology Division of Bangladesh maintains total 8 stations for precipitation sample collection aiming isotopic analysis under the Global Network of Isotopes in Precipitation (GNIP) program, which was initiated in 1958 by the International Atomic Energy Agency (IAEA) and the World Meteorological Organization (WMO). The stations are located in different climatic and geographic zones of the country namely, Dhaka (SR), Chuadanga (CN), Dinajpur (DN), Barishal (BS), Satkhira (KH), Sylhet (HT), Bandarban (BN) and Cox's Bazar (XB). Monthly samples collected from 2014-2016 period except Sylhet and Dhaka having a database for 2009-16 period were used for the study. Meteorological data in connection with the study were collected from Bangladesh Meteorological Department (BMD). Analysis of Isotopic data was done by Isotope Hydrology Laboratory of IAEA. The pattern of stable isotopic composition has been found different in different seasons in Bangladesh. For the period of January-May, enriched isotopic composition is found in stations, DN, CN, HT, SR and in BS. For Monsoon period (June-October) and November, the usual pattern is XB>CN>KH>DN>HT>SR>BS>BN, which indicates that the coastal stations are relatively enriched in both δD and δ18O, while the Barishal station is an exception. In Monsoon season, the variation range of δD (-75 to -18 ‰) and δ18O (-10.7 to -3.7 ‰) over the stations in Bangladesh. The weighted δDp and δ18Op values in precipitation show much similarity in all the stations (δ18Op= -5.43 to -5.13 ‰) except in BN (δ18Op= -6.31 ‰) and BS (δ18Op= -6.18 ‰). Local Meteoric Water Lines (LMWL) were constructed for each of the stations, where each of the stations follow the GMWL (Global Meteoric Water Line) very closely, except DN and XB to some extent. Pearson correlation coefficients were analyzed between δ18O and four meteorological variables, rainfall amount (RF), temperature (T), relative humidity (RH) and vapour pressure (Vp). It was observed that the non-monsoon precipitation is significantly influenced by these four meteorological variables with having negative correlations mostly. While different scenario is observed during the monsoon period. The rainfall amount and humidity seem to be the major controls, while rainfall is positively correlated with δ18O. From Isotopic compositions and its spatial distribution, it is observed that the precipitation moisture is mainly originated from the sea and travels through different parts of Bangladesh without significant recycling events. Seasonal variation of δp shows that, Non-monsoon months are mostly enriched in Isotopes, while successive depletion is followed by the monsoon months. The meteorological factors were found to be acting in a different way in different seasons.

2. Repair & Maintenance and Renovation Works

2.1 Repair gas box of Atomic Absorption Spectrophotometer

For measuring cations and heavy metals an Atomic Absorption Spectrophotometer (model: Analytik jena zenith-700) instrument has been used since 2008. There was a problem for producing stable flame during

sample analysis in flame mode. The clogged acetylene gas line and jammed gas valve were cleaned and repaired. The instrument is now functioning properly.

2.2 Cleaning and regular maintenance of UV spectrophotometer

The UV-visible spectrophotometer (model: Hach DR-4000) of Isotope Hydrology Lab which is used for analyzing anions, SiO_2 and COD got trouble on λ-calibration. The absorption filter was contaminated with microorganisms thus the filer was not functioning properly. For the disinfection and decontamination of the absorption filters, it was cleaned with a cloth moisturized with a mild cleaning agent followed by diluted alcoholic substance i.e. Isopropyl Alcohol. The problem was resolved.

3. Manpower Development and Training Program

Title of the event	Date	Place
Hydrochemical, Statistical and Isotopic Analysis of the Deep Aquifers of Patuakhali and Barguna, districts of Bangladesh	12 Dec. 2018	INST, AERE
An Overview on Isotope Hydrology Division and Introduction to IAEA-GNIP program in Bangladesh.	26 Jan. 2019	BINA, Gazipur
Application of Isotopic Techniques in Groundwater Research and A Case Study on Groundwater Salinity Investigation in Southwestern Coastal area of Bangladesh.	26 Jan. 2019	BINA, Gazipur

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

Name of the participants	Title of the event	Organizer	Date
M. M. Karim	2018 IAEA/RCA Technical Workshop on Ground Water Recharge and Dynamics Using Isotopic Techniques	IAEA	20-21 Sept. 2018
	International Symposium on Isotope Hydrology: Advancing the Understanding of Water Cycle Processes	IAEA	20-24 May 2019
M. A. Ahsan	Regional Training Course on Isotopic Data Processing and Interpretation-Hands on Exercises.	IAEA	18-22 Apr. 2019
A. H. A. N. Khan	2018 TPE Science & Technology Training	ITP, CAS	24 July-07 Aug. 2018
F. Islam	Regional Training Course on the Use of Isotope Techniques in Assessing Groundwater Quality	IAEA	06-10 Aug. 2018.
M. M. Karim, M. A. Q. Bhuyian, M. A. Ahsan, A. H. A. N. Khan, F. Islam	Bangladesh Chemical Congress 2018 (BCC2018)	Bangladesh Chemical Society	17-19 Oct. 2018
M. M. Karim, M. A. Q. Bhuyian, M. A. Ahsan, A. H. A. N. Khan, F. Islam	International Conference on Physics - 2019, Dhaka,	Bangladesh Physical Society	07-09 Feb. 2019
A. H. A. N. Khan, M. A. Q. Bhuyian, M. A. Ahsan, F. Islam, M. M. Karim, N. Ahmed	7th International Conference on Water and Flood Management	Institute of Water and Flood Management (IWFM), BUET	02-04 Mar. 2019
M. M. Karim	2018 IAEA/RCA Technical Workshop on Ground Water Recharge and Dynamics Using Isotopic Techniques	IAEA	20-21 Sept. 2018
	International Symposium on Isotope Hydrology: Advancing the Understanding of Water Cycle Processes	IAEA	20-24 May 2019

Name of the participants	Title of the event	Organizer	Date
M. A. Ahsan	Regional Training Course on Isotopic Data Processing and Interpretation-Hands on Exercises.	IAEA	18-22 Apr. 2019
A. H. A. N. Khan	2018 TPE Science & Technology Training	ITP, CAS	24 July-07 Aug. 2018
F. Islam	Regional Training Course on the Use of Isotope Techniques in Assessing Groundwater Quality	IAEA	06-10 Aug. 2018.
M. M. Karim, M. A. Q. Bhuyia, M. A Ahsan, A. H. A. N. Khan, F. Islam	Bangladesh Chemical Congress 2018 (BCC2018)	Bangladesh Chemical Society	17-19 Oct. 2018
M. M. Karim, M. A. Q. Bhuyian, M. A. Ahsan A. H. A. N. Khan, F. Islam	International Conference on Physics - 2019, Dhaka,	Bangladesh Physical Society	07-09 Feb. 2019
A. H. A. N. Khan, M. A. Q. Bhuyian, M. A. Ahsan, F. Islam, M. M. Karim, N. Ahmed	7th International Conference on Water and Flood Management	Institute of Water and Flood Management (IWFM), BUET	02-04 Mar. 2019

5. Service Rendered and Revenue Income

Name of service given to the organization	Name of sample	No. of sample	Income
Institute of Water and Flood Management (IWFM), BUET	Biological Oxygen Demand (BOD) analysis of water samples	10	20,000/-
	Heavy Metal Analysis of sediment samples	09	13,500/-

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 technique. These research groups mainly focus on characterization of essential materials, elemental analysis of toxic and heavy elements and studies of structural and building materials for defects and flaws.

Activities/Program(s)

1. Research and Development Work(s)

Neutron Activation Analysis

1.1 Concentration and distribution of trace elements in sediments of the Padma river nearby Rooppur Nuclear Power Plant project

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

Sediment samples from twelve sampling points of the Padma river near Rooppur Nuclear Power Plant (RNPP) area were collected and analyzed by research reactor based neutron activation analysis (NAA) technique to study contamination and distribution of the elements in sediments of the river. Total concentrations of 20 major and trace elements (Na, Al, K, Ca, Sc, Ti, V, Mn, Fe, As, Sb, La, Sm, Dy, Ho, Yb, Lu, W, Th and U) in sediments of the river are reported. In this study, pollution level of pollutants evaluated

by different pollution indices indicate that sediments of the Padma river are minorly polluted by Ca, Sb, La, Sm, Dy, Ho,Yb, Lu, Th, U and moderately polluted by W. The Geo-accumulation index valuesindicates that the sediments are uncontaminated to moderately contaminated by Yb, W and Th. The calculated pollution load index values also suggested the deterioration of the sediments at some points. This study will be helpful to set a picture of elemental contamination of the river nearby RNPP area.

1.2 Assessment of trace element contamination in sediments of the Madhumati river using neutron activation analysis

M. A. Islam, S. S. Datta, M. R. Rahman, K. Naher, R. Khan, S. Das, U. Tamim, S. M. Hossain, M. A. Azam, M. A. Ali, M. A. A. Talukder, I. Khalil and M. S. Islam

In this study, concentration of 23 major and trace elements in sediment samples collected from 12 locations of the Madhumati river, Gopalgonj were determined to study the spatial distributions and contamination status of the elements in the sediments of the river. When compared with upper continental crustal (UCC) average values, it is observed that mean concentrations of Al, K, Sc, Ti, Fe, Zn, As, Rb, Cs, Ce, Tb, Dy, Hf, U and Th show elevated values with respect to UCC values. The enrichment factor (EF) values of the environmentally toxic elements As and Th (EF =1.5- 3.0) at most of the sampling points indicate that Madhumati river sediments are minorly enriched with these two elements. The Madhumati river sediment is practically uncontaminated by rest of elements. In this study, the calculated pollution load index (PLI) values among the sampling points vary from 0.461–1.29, which indicates the progressive deterioration of the sediment quality of the river. Since there is no literature data available on elemental concentration of the sediments of the Madhumati river, this study will be used as baseline data for future contamination study of this river.

1.3 Characterization of chemical elements in common spices of Bangladesh for dietary intake and possible health risk assessment by INAA and AAS techniques

M. A. Islam, S. S. Datta, M. R. Rahman, K. Naher, R. Khan, S. Das, U. Tamim, S. M. Hossain, M. A. Azam, M. A. Ali, M. A. A. Talukder, I. Khalil and M. S. Islam

In this study, total concentrations of seventeen chemical elements (Al, As, Br, Ca, Cd, Cl, Co, Cr, Fe, K, Mn, Na, Ni, Pb, Sc, V and Zn) in Bangladeshi common spices were determined using instrumental neutron activation analysis (INAA) and atomic absorption spectrometry (AAS) techniques. This study indicates that spices are a good source of a combination of Ca, Fe, K, Mn, Na and Zn minerals. The concentrations of the elements As, Cd, Cr and Pb in some spices were higher than WHO and FAO permissible levels. However, health risks associated with these elements evaluated by dietary intake, target hazard quotient and target carcinogenic risk indices indicate that people would experience no potential risks due to consumption of the spices.

1.4 Experimental cross sections of the $^{174}Yb(n,\gamma)^{175}Yb$ reaction at 0.0334 eV and 0.0536 eV energies

M. A. Islam, S. S. Datta, M. R. Rahman, K. Naher, R. Khan, S. Das, U. Tamim, S. M. Hossain, M. A. Azam, M. A. Ali, M. A. A. Talukder, I. Khalil and M. S. Islam

The cross sections of the $^{174}Yb(n,\gamma)^{175}Yb$ reaction at energies of 0.0334 eV and 0.0536 eV were measured for the first time using monochromatic neutrons from a neutron diffractometer and a neutron spectrometer at TRIGA Mark II research reactor. The $^{197}Au(n, \gamma)^{198}Au$ reaction was used to monitor the neutron beam intensity. The radioactivity of the product nuclides was determined via high resolution gamma-ray spectrometry system. The obtained cross section values at 0.0334 eV and 0.0536 eV are 56.8 ± 3.7 b and 44.2 ± 2.6 b, respectively after the correction for neutron self-shielding and gamma-ray attenuation effects. The measured data are consistent with both the ENDF/B-VIII and JENDL-4.0 data libraries, however, 45**%** less than the theoretically evaluated JEFF-3.3 data. Those measured values were extrapolated to the 0.0253 eV energy assuming 1/v dependence in the thermal energy region and the results were compared with the integrally measured values reported in the literature. Since Yb is a potential candidate to be used as neutron absorber and structural material in nuclear reactor, the new data are useful to check the evaluated excitation function to resolve discrepancies of the data at thermal energy region for the studied reaction which can be used for the proper estimation of criticality safety and radiation doses.

1.5 Distribution of elements in the beach sands of St. Martin's Island, Bangladesh

R. Khan, S. Saha, M. A. Haydar, M. M. Karim, K. M. N. Alam, A. A. Amin, A. H. M. Saadat, K. Naher, M. A. Islam, S. Das, U. Tamim, S. M. Hossain, M. A. Azam, M. A. Ali, M. A. A. Talukder, I. Khalil, M. S. Islam and M. S. Islam

This study has been carried out on the concentrations of constituent (major, minor and trace) elements present in sand samples collected from Saint Martin's Island which is one of the important tourist spots in Bangladesh. The objectives of this study were to provide the background data for the elemental contents as well as to draw the future aspects of sediment contamination in terms of the elemental abundances. In carrying out the analysis, TRIGA Mark-II research reactor and Gamma-spectrometry based Instrumental Neutron Activation Analysis (INAA) was adopted due to its versatile applicability and non-destructive nature. A total of 30 elements, i.e., Na, Al, K, Ca, Sc, Ti, V, Cr, Mn, Fe, Co, Zn, As, Br, Sb, Rb, Cs, Ba, La, Ce, Sm, Eu, Tb, Dy, Yb, Lu, Hf, Ta, Th and U were determined from sixteen sand samples by INAA. Both geochemical and anthropogenic origins of heavy metals (HMs) are considered during the evaluation of compositional trends by the environmental indices such as contamination factor (CF), pollution load index (PLI), geo-accumulation index (Igeo), enrichment factors (EF) and the inter-element correlation analysis.

1.6 Determination of elemental composition of cow milk and assessment of health risks

R. Khan, A. A. Amin, K. M. N. Alam, A. H. M. Saadat, R. Huque, A. Khatun, M. A. Rahman, K. Naher, M. A. Islam, S. Das, U. Tamim, S. M. Hossain, M. A. Azam, M. A. Ali, M. A. A. Talukder, I. Khalil and M. S. Islam

Cow milk is one of the important dietary items for the human beings, especially for the children. So the content of heavy elements in the cow milk should be studied to assess the potential health risk. To study the elemental distribution in the cow milks obtained from the eastern (Sylhet) part and south eastern part (Chattogram) of Bangladesh were analyzed by TRIGA Mrak II research reactor and gamma spectroscopy based Instrumental Neutron Activation Analysis (INNA). A total of 22 elements (Na, Mg, Al, K, Ca, Sc, V, Cr, Mn, Fe, Co, Zn, Br, Rb, Sb, Cs, Eu, Yb, Lu, Hf, Ta and Th) were determined in milk samples. For INAA, milk samples were first fridge dried to obtain powdered milk and the powdered milk were then converted to their corresponding ash. To assess the potential health risk, different indices, e.g., Daily intake of metals, health risk index, hazard index, metal pollution index related to human health are also calculated. This analysis of index calculation is to find out the concentration of different metals and their threshold limit in human health. Extent of this study should be on identification of source of metals. By this complete study it also would be possible to prescribe remediation measures.

1.7 Investigating elemental concentration and potential contamination in Tista river sediment

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

The main focus of the study is to determine the available constituent on sediments which may include major, minor, trace and rare earth elements. In order to determine those elements Instrumental Neutron Activation Analysis is used. A total of 33 elements are determined from a total of 30 sediments samples. The standard soils and sediments sample is also analyzed in middle of the collected sample in order to judge the quality of irradiation and precision of the outcome. In the case of Geo-accumulation and Enrichment factor most of the elements like Na, Al, K, Ca, Sc, Ti, V, Cr, Mn, Fe, Co, Ni, Zn, Ga, As, Sb, Rb, Cs, and Ba shows practically no pollution where the rest of the elements like Ce, Nd, La, Lb, Sm, Tb, Ho, Yb, Hf, Ta and U are uncontaminated to moderately contaminated levels. The sample point T-7 is moderately contaminated by Nd, Sm, Tb, Ho and ranked in top contaminated in sample points. Th is practically most dominant contaminant in the sample points because it present in almost all the sample location in a excessive level and most concentration is seen in T-2, T-4 and T-7. The PLI analysis of the obtain concentration of 33 elements shows that anthropogenic origin of some elements like Ce, Nd, La, Lb, Sm, Tb, Ho, Yb, Hf, Ta and U when the rest of the elements are geochemical origin. The PLI shows the sample site T-7 are comparatively more polluted than the rest of the sample points. So, to reduce the heavy metals pollution or to keep the ambient quality of the environment source of anthropogenic heavy metals showed be minimized as far as possible.

1.8 Assessment of elemental contamination in Brahmaputra river sediment by instrumental neutron activation analysis

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

The present study has been carried out on the concentrations of constituent (major, minor and trace) elements present in sediment samples collected from different parts of Brahmaputra River. The objective of this study is to provide the background data for the elemental contents as well as to indicate sediment contamination in terms of the elemental abundances. A total of 33 elements, i.e.,Na, Al, K, Ca, Sc, Ti, V, Cr, Mn, Fe, Co, Zn, Ga, As, Br, Sb, Rb, Cs, Ba, La, Ce, Nd, Sm, Eu, Tb, Dy, Ho, Yb, Lu, Hf, Ta,Th and U were determined from nine soil samples by INAA. Geo-accumulation index shows that Hf is moderately contaminated in just one location while La, Ce, Nd, Sm, Eu, Tb, Dy, Ho, Yb, Lu, Hf and Th are uncontaminated to moderately contaminate. All the other elements are found as uncontaminated. Enrichment of some heavy metals such as La, Ce,Yb, Lu, Hf, and Th are evidence of minor modification. But in some cases the enrichment of Hf and Th are evidence of moderate modification and all are originating from the anthropogenic source(s). PLI indicates that most of the elements has no pollution level. Some other elements are considered as polluted as like La, Ce, Nd, Sm, Eu, Tb, Dy, Ho, Yb, Lu, Hf and Th as they has values more than one. The data reveals that elemental content in the IAEA-Soil-7 and IAEA-SL-1 is almost very close to the certificate value. They have significant co-relation with those of the elemental abundances in sediment samples of this study.

1.9 Heavy metal contamination of benthic sediment of Turag river near industrial effluent discharge location

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

To estimate the geochemical environment of the river, eleven heavy metals, namely Cr, Mn, As, Ni, Cu, Zn, Cd, Pb, Th, V and U, were examined from the freshly deposited river bed sediments of Turag River. All the sediment samples were collected from eleven different locations and from each location three to five samples were collected at varying depth. Trace element contamination assessment reveals that, Zn, As, Ni and Cu are low to moderately contaminate, while Mn, V and Th is moderately to severely contaminate in the sediments of this area, with a common trend of metal concentration ofV>Mn>Th>Zn>U>As >Cu >Ni>Cr>Pb. As expected, the highest concentrations of metals in the sediment samples were most frequently found in the upper layers while the lowest concentrations were mostly observed in the bottom samples. This indicates that the untreated and/or partially treated industrial and municipal wastewater discharges along the river bank are major sources of pollution. Result showed that heavy metal concentration ranged between 161 and 34 mg/kg for V, 58.35 and 4.96 mg/kg for Mn, 35.3 and 6.2 mg/kg for Th, 11.66 and 1.11 mg/kg for Zn, 5.48 and 1.37 mg/kg for U, 11.06 and 0.16 mg/kg for As, 7.12 and 0 mg/kg for Cu, 2.59 and 0.28 mg/kg for Ni, 2.7 and 0 mg/kg for Cr and 3.56 and 0.04 mg/kg for Pb at different depths. The highest contamination degree of the sediment was noticed at Location 1 (Dying industry discharge point) and lowest at Location 9 (near Dhaka Ashulia Highway) and the pollution level varies systematically with the sampling depth and the distance from the contamination source. To determine the heavy metal distribution in water and surface sediments of the analyzing river, water samples were collected from six different locations at a depth of 0-5cm from the surface. After analysis it was found that the river water is less contaminated compared to the bed sediment samples by toxic metals during the study but the sediment quality may degrade in the near future due to increasing anthropogenic inputs in the river basin, hence proper management strategies are required to control the direct dumping of wastewater in the river.

Neutron Radiography

1.10 Study of ancient brick samples, found in Bangladesh, with neutron radiography method to observe their internal structure and characteristics

R. Barman, S. Saha and M. S. Islam

Neutron radiography (NR) has been applied successfully to investigate different types of building materials, rock samples, sculpture, statue or monuments since long. In present research, thermal neutron beam at tangential beam port of 3MW TRIGA Mark II research reactor has been utilized to determine the internal structure of different brick samples, collected from Mahasthangarh and Sonargaon. Manufacturing building

materials has become very good option for business in the developing countries like Bangladesh. Among the NDT techniques, neutron radiography is the most common procedure to identify light materials, homogeneity, any inclusion or voids or cracks etc. inside structure. The radiographic images in dry condition for individual samples have been investigated and it can be concluded with the statement that brick sample from Mahasthangarh is more homogeneous inside.

1.11 Investigation of glass samples as scintillation screen for neutron imaging

S. Saha, H. J. Kim, R. Barman and M. S. Islam

Neutron radiography facility of Bangladesh Atomic Energy Commission at AERE, Savar is in a transition period for upgradation to the digital neutron imaging facility. The scintillation screen of the digital imaging system is under investigation in this experiment replacing with glass samples to choose the combination of crystal for this purpose. The glass samples were irradiated for 5 and 10 minutes separately by thermal neutrons at the tangential beam port of the BAEC TRIGA research reactor at 2.2 MW power. $10Y_2O_3{:}60Li_2O_3{:}(30\text{-}1.5)B_2O_3{:}1.5Eu_2O_3$ (mol%) has been selected from three different glass samples of different compositions to be fabricated as crystal for having good sensitivity to thermal neutrons.

1.12 Evaluation of beam quality at tangential beam port of TRIGA research reactor of BAEC using neutron radiography technique

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

Neutron radiography facility of BAEC is been utilized to perform a variety of research using direct film neutron radiography technique. To assure admissible performance, inspection of the facility in regular interval needs to be performed using international standardization tools. American Standard of Testing and Material (ASTM) has prepared two devices named BPI and SI, which have been utilized here to evaluate the beam quality of the facility. The result of this investigation is varied depending on the converter foil but shows a decreasing number of thermal neutrons since the previous study in 2007.

1.13 Comparative study of reinforcement bars from different brands available in Bangladesh using neutron radiography technique

R. Barman, S. Hossain and M. S. Islam

Radiography using ionizing radiations is one of the oldest and most important tools in the examination of nondestructive imaging technique that is capable of visualizing the internal characteristics of the test specimen. In the present work, thermal neutron beam at tangential beam port of 3MW BAEC TRIGA research reactor has been utilized to determine the internal structure of different rebar samples, collected from different manufacturing brands available in Bangladesh. The nondestructive determination of the kind, position and geometry of rebars and other metallic fittings in building elements is important for the evaluation of the load bearing capacity and the usage property within the scope of building condition and damage analysis. Four rebar samples from three different brands have been investigated and rebar sample-2 from Mohammadi Steel Works (MSW) Ltd. has been found to be more homogeneous than other samples. It has been also found that rebar sample-1 from Kabir Steel Rolling Mills has higher percentage of neutron stoppage per unit volume than the others.

Neutron Scattering

1.14 Cation distribution, structural and magnetic characterization of Ni-Cu-Zn ferrites

I. B. Elius, I. Kamal, A. K. M. Zakaria, S. Hossain, M. S. Aktar, J. Maudood, M.A. Hai and F. Ahmed

The Ni-Cu-Zn ferrites are one of the most intriguing spinel oxides so far because of its diverse applications. In the current study the ratio of nickel and copper was varied keeping the concentration of zinc constant primarily aiming to examine its effect cation distribution as well as structural and magnetic parameters. The samples were synthesized via conventional solid state reaction method then subjected to neutron diffraction studies in SAND laboratory at BTRR, AERE, Savar. The magnetic properties were also measured using vibrating sample magnetometer (VSM) which complements the magnetic measurements from the neutron diffraction studies.

1.15 Study of Sn doped gadolinium cerate as electrolyte material for intermediate temperature SOFCs

S. Hossain, I. B. Elius, I. Kamal, A. K. M. Zakaria, M. S. Aktar, J. Maudood, M. A. Hai and F. Ahmed

In the present study two samples $Gd_{2-x}Sn_xCe_2O_7$ (x = 0.1, 0.2) named as GSC1 and GSC2 were synthesized by the conventional solid state reaction method. All the samples were sintered at 1300°C for 10 hours in air atmosphere. The samples were characterized by using the X-ray diffraction method (XRD), surface morphology was checked using scanning electron microscopy (SEM. The X–ray diffraction pattern showed that both the samples possess single phase cubic crystal symmetry with Fm-3m space group. With the help of the sotware "*Checkcell*", the samples were indexed and the lattice parameter 'a' was calculated. It was found to be 5.400 Å and 5.4161 Å for the sample GSC1 (x = 0.1) and GSC2 (x = 0.2) respectively. Using '*BondStr'* code, the bond lengths between various constitutional atoms was also calculated. The Rietveld refinement of the XRD data was done by using the *FullProf* suite program. Form the SEM analysis dense ceramics with increasing grain size was obtained resulting from stannum incorporation which promotes sinterability of $Gd_{2-x}Sn_xCe_2O_7$. The average grain size for GSC1 and GSC2 was found to be 1.649 μm and 2.266 μm respectively.

2. Manpower Development and Training Program

Title of the event	Date	Place	No. of participant
Internship program for the undergraduate students of Department of Nuclear Science and Engineering, Military Institute of Science and Technology, Dhaka	Nov, 2018	RNPD, INST	03
Industrial Training for the undergraduate students of Nuclear Engineering Department of University of Dhaka	Apr. 2019	RNPD, INST	02
Internship program for the undergraduate students of Chemistry Department of Mawlana Bhashani Science and Technology University	Sept. 2018	RNPD, INST	06

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

Name of the participant	Title of the event	Organizer	Date	Place
Dr. K. Naher	Training workshop on expansion of the research reactor stakeholder base through strategic and business plans	JAEA, MEXT	12-16 Nov. 2018	Vienna, Austria
	FY2018 FNCA joint workshop on RRU and NAA	NSRA, MEXT	22-25 Oct. 2018	Osaka, Japan
Dr. M. A. Islam	Instructor Training Course: Reactor Engineering III (Reactor safety) - 2018.	JAEA	20Aug. -12 Oct. 2018	JAEA, Tokai-mura, Japan
	FNCA Workshop on Research Reactor Utilization	FNCA, Japan	Oct. 22-25, 2018	Osaka, Japan
Dr. R, Khan	IAEA/TC/BDG5032: Fellowship on sampling and analysis of stable isotope and trace elements	IAEA	25 Jun. - 06 Jul. 2018	University of Otago, Dunedin, New Zealand
Dr. K. Naher, Dr. M. A, Islam, Dr. S. Hossain, I. B. Elius and J. Maudood	National Conference on Physics – 2019	Bangladesh Physical Society	07 - 09 Feb. 2019	Department o Physics, University of Dhaka
Dr. S. Hossain	INPRO Dialogue Forum on Opportunities and Issues in Non-Electric Applications of Nuclear Energy	IAEA	14-16 Dec. 2018	Vienna, Austria

Name of the participant	Title of the event	Organizer	Date	Place
	Technical Meeting on Neutron Scattering and Spectroscopy with Low and Medium Flux Neutron Sources	IAEA	13-16 May 2019	Vienna, Austria
I. B. Elius	RCARO/KAERI Training Course on Radiation Technology and its Applications	KAERI	15-26 Oct. 2018	KAERI, Korea
	Nuclear Cyber Security Awareness Training Program	BAEC	12-13 Nov. 2018	ICS, Savar, Dhaka
I. B. Elius, R. Barman	Reactor Engineering Course	BAEC & JAEA	10-28 Feb.	TI, Savar, Dhaka
R. Barman	Regional Training Course for Beginners on Basic Non-Destructive Testing Methods and Radiation Technologies for Measurement	IAEA and Malaysian Nuclear Agency	26 Nov. - 07 Dec. 2018	Malaysia
	Environmental Radioactivity Monitoring Course (ERMC-7)	BAEC & JAEA	13-17 Jan. 2019	TI, Savar, Dhaka
J. Maudood	Basic Nuclear Orientation Course (BNOC)-2018 (2nd batch)	BAEC	09 Sept. - 01 Nov. 2018	TI, Savar, Dhaka
	Training Course on Radiation Protection for Radiation Workers and RCOs of BAEC, Medical Facilities & Industries-2018	BAEC	05-09 Aug. 2018	TI, Savar, Dhaka

4. Collaboration Work/MoU

Collaboration with

- Indian Institute of Technology, Kharagpur, India
- Prince of Songkla University, Thailand
- Chalmers University of Technology, Sweden
- University of Brunei Darussalam, Brunei Darussalam
- Two FNCA projects

a. Research Reactor Utilization/NAA

b. Research on Climate Change using Nuclear and Isotopic Techniques

5. Others

Dr. Mohammad Amirul Islam, Principal Scientific Officer of RNPD Division achieved "The World Academy of Sciences **(**TWAS), Italy **–** Bangladesh Academy of Sciences **(**BAS**)** Young Scientist Gold Medal Award-2018" in Physical Sciences and Engineering.

6. Service Rendered and Revenue Income

Name of Service	No. of samples	Income
Determination of Arsenic in Vegetable sample	28	16,800/-
$MgZnYFe_2O_4$	04	-
$BaCe_{0.7}Zr_{0.1}Y_{0.15}Zn_{0.05}O_3$	01	-
$BaCe_{0.5}Zr_{0.3}Y_{0.1}Yb_{0.05}Zn0_{0.05}O_3$	01	-
$BaCe_{0.7}Zr_{0.1}Pr_{0.1}O_3$	01	-
$Sr_{0.9}Ba_{0.1}WO_4$	01	-

INSTITUTE OF ELECTRONICS (IE), AERE

General Electronics Division, IE

Objective

This division deals with the design, development and fabrication of electronic and nuclear instruments which are mainly used for test and measuring purposes. A number of Nuclear Instruments have been designed in the General Electronics Division. These are Portable Radiation Dose Rate Meter (PRDM), Hand and Foot Radiation Monitor (HFRM) and Area Radiation Monitor (ARM). These Instruments have been supplied to different Institutes and Industries of the country.

Activities

1. Research and Development Work(s)

1.1 Microcontroller based portable radiation dose rate meter (MDGE)

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

1.2 Microcontroller based hand foot and cloth contamination monitor

In order to improve the nuclear safety features of the existing Hand and Foot Radiation Monitor, the Microcontroller-Based Hand Foot and Cloth Contamination Monitor has been designed and fabricated and working satisfactorily.

1.3 Design and development of microcontroller based chiller controller

Microcontroller Based Chiller Controller has been designed for VLSI Laboratory and working satisfactorily.

1.4 Design and development of a microcontroller based temperature controlled large area hot plate

It is a customized instrument for Nuclear and Radiation Chemistry Division of INST which is generally used to drying the sample for research purpose. The area of the Hot plate is 18"X18"and temperature range from room temperature to 100^0C at graduation of 5^0C. The instrument is working satisfactorily. Development work of this instrument is going on.

1.5 Design and development of laboratory power supply

It is also a customized instrument for Radio Isotope and Production Division (RIPD). This division has Laboratory scale. To operate this scale a Laboratory Power Supply has been designed and developed in GED. The instrument is working satisfactorily.

2. Lecture Delivered

The scientists/Engineers of this division delivered lectures in the BNOC-2018 "An overview of embedded and PC based nuclear instruments"

3. Manpower Development/Training Program(s)

Name of the participant	Title of the event	Organizer	Date	Place
M. Alam	BNOC-2018	TI	09 September – 01 November, 2018	TI, AERE
F. Hafiz, M. Alam and M. A. H. Chowdhury	Radioactivity Monitoring Instruments	IE, AERE	13-17 Jan. 2019	IE
F. Hafiz	Electronic Government Procurenment (e-GP) System	TI, AERE	31 Mar.-4 Apr. 2019	TI

4. Lecture Delivered and Practical Demonstration

- The scientists/Engineers of this division delivered lectures in the Industrial Attachment Training Programme from 03 Feb ,2019 to 30 Apr,2019 held in Institute of Electronics for the students of different Polytechnic Institute of Bangladesh
- The scientists/Engineers of this division have delivered lectures in the Industrial Attachment Training Programme from December 23, 2018 to December 27, 2018 held at Institute of Electronics for the students of Military Institute of Science & Technology (MIST), Mirpur Cantt. Dhaka

- Practical Course for Nuclear Engineering Students, Dhaka University has been held from 16 April 2019 to 28 April, 2019
- In house Training Arranged by the course co-ordinator Farhana Hafiz "Unicode and Bangla typing in Avro" held from 06/01/2019 to 10/01/ 2019

5. Other Activities

5.1 Production Works

- Portable Microcontroller Based Radiation Dose Rate Meter, MDGE-11, Serial no-101801 supplied to, Lafarge cement
- Power Supply, Supplied to RIPD, INST, AERE

5.2 Repair and Maintenance Work(s)

- Portable Radiation Dose Rate Meter, DRGE-31, Serial no- 070402 TK. Chemical has been repaired at 12 August, 2018
- Beta Gamma Contamination Monitor, Bethold LB122 of Atomic Energy Center, Chattogram, has been repaired at 7 November 2018
- Portable Radiation Dose Rate Meter MDGE-11, Serial No- 090202 of BSMU, Cox's Bazar has been repaired at 31 December, 2018

Nuclear Electronics Division, IE

Objective

This division deals with the Design, development and fabrication of nuclear instruments for laboratory use, Refurbishment of nuclear instruments, Repair, maintenance and installation of nuclear and non-nuclear equipment. These are mainly used in different laboratory of inside and outside BAEC. Beside this the division also involve in Supervise or Guide thesis work, Human resource development and training program etc.

Activities

1. Research and Development Work(s)

1.1 Design, development and fabrication of the area radiation monitor (ARM)

Area Radiation Monitors are used in nuclear installations to ensure radiation safety of the personnel. Design and Development of microcontroller based digital ARM has been completed in cooperation with General Electronics Division. Development work for inclusion of more channels is going on.

1.2 Design and development of a gamma source control console (GSC)

Gamma Source control Console (GSC) is a customized controller for 90kCi Co-60 Gamma irradiator for its research and industrial application. The failure of BRIT supplied control console it stopped Research and industrial application related to the Irradiator. An emergency system has been setup to continue the Research and industrial application. A step has been taken to develop a control consol that will control and displays Irradiation time of the Co-60 source along with Compressor ON time. Development work is going on.

1.3 Design and development of ultrasonic humidity controller

It is a customized instrument for Insect Biotechnology Division of IFRB which is control the humidity of laboratory. Two Ultrasonic Humidity Controller has been designed and supplied to IBD, IFRB and another one is fabricated. The development work of another unit of Humidity Controller is going on.

1.4 Production of Electronic Gazettes

Two Ultrasonic Humidity Controller has been manufactured and supplied to IBD, IFRB.

2. Repair and Maintenance Work

One Incubator, Model: BD115, Serial No:08-54027, Manufacturer:BINDER, Country of Origin-Germany of RIPD, INST, AERE.

3. Manpower Development/Training Program(s)

Name of the participant	Title of the event	Organizer	Date	Place
F. Akter	Instructor training Course (ITC) (Reactor Engineering-1)	JAEA	20 Aug.-12 Oct. 2018	Japan
	Radioactivity Monitoring Instrument	IE, AERE	13-17 Jan. 2019	IE
	Electronic Government Procurenment (e-GP) System	TI, AERE	31 Mar.-4 Apr. 2019	TI

4. Lecture Delivered

- The scientists/engineers of this division have delivered lectures in the Industrial Attachment Training Programme from 03 Feb, 2019 to 30 Apr, 2019 held at Institute of Electronics, AERE,Savar,Dhaka for the students of different Polytechnic Institute of Bangladesh.
- The scientists/engineers of this division have delivered lectures in the Industrial Attachment Training Programme from 23-27 Dec. 2018 held at Institute of Electronics for the students of Military Institute of Science & Technology (MIST), Mirpur Cantt. Dhaka.
- The scientists/engineers of this division delivered lectures in the BNOC-2018.

5. Training Arranged

Industrial Attachment Training Programme arranged by the course co-ordinator Fahmida Akter from December 23, 2018 to December 27, 2018 held at Institute of Electronics for the students of Military Institute of Science & Technology (MIST), Mirpur Cantt. Dhaka.

6. Other

An ADP project "Improvement and modernization of the laboratory Facilities of Institute of Electronics"is going on.

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/Program(s)

1. Production of Instruments

1.1 Production of A.C. voltage stabilizer: Quantity - 02

Specifications:

Upper cut-off voltage: 270V, Lower cut-off voltage: 120V,Time delay: Direct (No delay), 30 sec (For TV/Comp),: 3 min (For Fridge),Stabilized output: 205-235V, Input voltage: 220VAC, 50Hz, Type: 160-250V,Weight: 8 Kg (Approx.).

1.2 Production of drop-out-relay: Quantity - 07

Specifications

Upper cut-off voltage: 250V, Lower cut-off voltage: 160V, Time delay: 3 min (Adjustable),Input voltage: 220VAC, 50Hz,Output (safe range),: 160-250V,Weight: 1.8 Kg (Approx.).

2. Repair & Maintenance and Renovation Works

- Repaired of Digital pH Meter: Quantity – 1
- Repaired of A.C. Voltage Stabilizer: Quantity - 02
- Repaired of Drop-Out-Relay: Quantity – 01

3. Manpower Development and Training Programme

The scientists/Engineers of this division delivered lectures in the Industrial Attachment Training Programme from 03 Feb, 2019 to 30 Apr, 2019 held in Institute of Electronics for the students of different Polytechnic Institute of Bangladesh.

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/Program(s)

1. Repair & Maintenance Work(s)

About Twenty four (24) instruments are repaired, maintained and installed during this time according to the requisition of the user. The main Instruments are: GFL Shaker, MGX II Geophysical Logging System, Sample Homgexiger, Sonicator, Microscope, Testometric Universal Testing Machine, Tandam Accelerator Machine, etc. The division repaired the instruments which approximate price is 30,00000/-

2. Manpower Develpemnt and Training Program

- The scientists/Engineers of this division have delivered lectures in the Industrial Attachment Training Programme for the students of different Polytechnic Institute of Bangladesh, 03 Feb. 2019 to 30 Apr. 2019, Institute of Electronics, AERE, Savar, Dhaka
- The scientists/Engineers of this division have delivered lectures in the Industrial Attachment Training Programme for the students of Military Institute of Science & Technology (MIST), Mirpur Cantt. Dhaka, 23-27 Dec. 2018, Institute of Electronics, AERE, Savar, Dhaka

Robotics Instrumentation and Control Division, IE

Objective

The objective of the division is to develop Robotics and Remote handling tools for laboratories of Bangladesh Atomic Energy Commission (BAEC).

Activities

1. Research, Design and Development Work(s)

1.1 Design and construction of an automatic water level controller

Automatic water-level controller is an electronic circuit that is designed for overhead tanks that switches on/off the pump motor when water in the tank goes below/above the minimum/maximum level. The water level is sensed by two sensors /floats to operate the switches for controlling the pump motor.

1.2 Design and development of an air conditioner change over system

A programmable Air Conditioner Change Over System has been designed and manufactured. It can control the temperature of a room /laboratory. One Air Conditioner Change over System has been supplied to IFRB, AERE, Savar and it is working satisfactorily.

2. Manpower Development and Training Program

- The scientists/Engineers of this division delivered lectures in the Industrial Attachment Training Programme from 03 Feb, 2019 to 30 Apr, 2019 held in Institute of Electronics for the students of different Polytechnic Institute of Bangladesh.
- Shahana Sultana, SE, has been participated in training course on "Radioactivity Monitoring Instruments" from 13-17 Jan. 2019, organized by Institue of Electronics, AERE, Savar, Dhaka.
- Industrial Attachment Training Programme has been arranged for the students of Polytechnic Institute at the Institute of Electronics (IE), Atomic Energy Research Establishment (AERE), Savar, Dhaka, in the Industrial Attachment Training Programme from 13-17 Jan. 2019

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 conducting 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 Work(s)

Fabrication and characterization monocrystalline silicon solar cell

Silicon is the second most abundant element in earth crust, safe for the environment and widely used semiconductor material. Therefore, silicon-based crystalline photovoltaic (PV) cells are widely used internationally. In a solar cell, surface texturization plays a key role in improving cell efficiency and is advantageous for cost-effective crystalline silicon solar cells. A textured surface can effectively reduce the reflectance of light on the surface of the cells by enhancing adequate light absorption via multiple reflections inside the cells than the flat surface, thus increases the cell efficiencies. Texturization of silicon wafers is performed by using the different chemical recipe. After that wafers are subjected to phosphorus diffusion by a diffusion furnace at 875 °C temperature using POCl3 for the formation of the n-p junction. Then, a screen printer is used to print the phosphorus-doped Si wafer by silver (Ag) and aluminum (Al) paste. The screen-printed wafers were heated at 120 °C temperature inside a preheated oven to ensure the qualitative contact metallization in terms of strong bonding between the paste and wafers. A high-temperature contact-firing step was followed by rapid thermal annealing (RTA) furnace to cure the ohmic contact of Si solar cell. Finally, different characterization techniques are used to measure the performance of solar cells.

Very Large Scale Integration 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

1. Research and Development Work(s)

- Research on thin film electronic, optoelectronic materials and condensed matter for high performance electronic device
- Effect of radiation on semiconductor material used in electronic device
- 2-D material, quantum dot and quantum materials for next generation electronics and solar cell applications
- 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 main activities of Nuclear Cyber Security Division (NCSD) are to conduct basic & applied research on nuclear cyber security, computer network and information security. NCSD also provides training in the field of relevant security issues and computer science 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 IT enabled 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 up gradation of inter-network infrastructure of BAEC through ensuring security at core level network system, manpower development. Establishing a data center is going on under the supervision of NCSD Lab for the data security and digitalization of different activities for the Commission. NCSD has developed online e-learning management portal with moodle based software with the concern of human recourses development and nuclear cyber security awareness to the public. The NCSD works for the implementation of secure nothi system at BAEC as administration of E-Nothi system

Activities/Program(s)

1. Research and Development Work(s)

1.1 Research on computer network and nuclear cyber security at BAEC

M. S. Islam and M. D. Hossain

Internal network like LAN and Wi-Fi system has been designed and developed at BAEC HQ, AERE and AECD. There also many computers and digital control systems are covered with these networks publicly or privately. So it's a crucial issue to ensure security in both computers application level, network level, information level and data security area. So by research and establishing a nuclear cyber security lab, it will help To prevent, detect and respond to malicious or unauthorized acts directed at nuclear & radioactive material and providing high assurance that digital computer, communications system and networks are adequately protected against cyber attacks to computer base process & nuclear sensitive information.

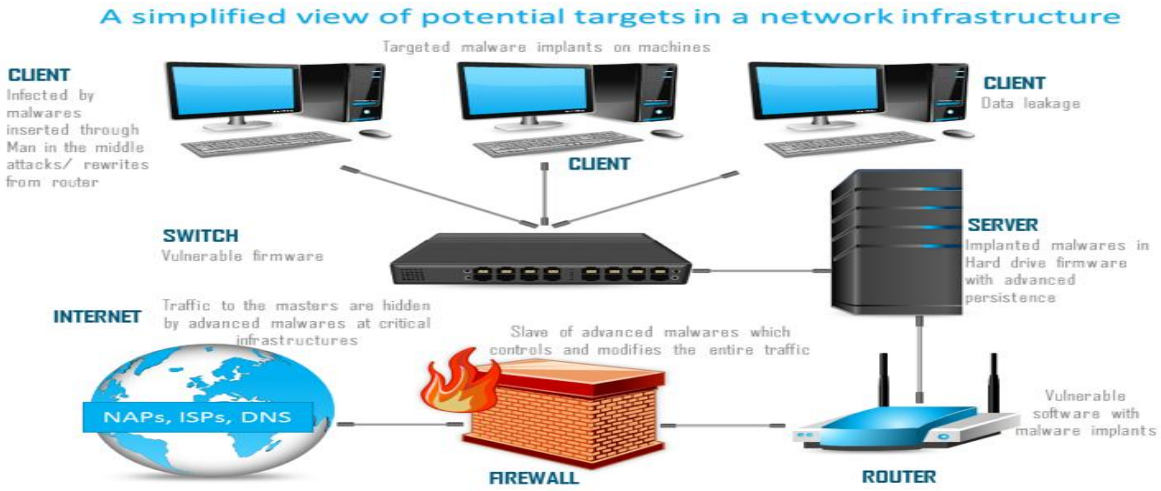


Fig: A Simplified AERE Inter network Architecture

Currently, a cyber security based documentation are prepared in BAEC and a cyber security lab establishment procedure and related Research activities is going on.

1.2 Implementing Moodle based E-learning management system for the expansion of nuclear education at BAEC

M. S. Islam and M. D. Hossain

BAEC is a multidisciplinary research organization where various researches are going on in different fields. For this purposes different institutes of BAEC offer 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 programs.

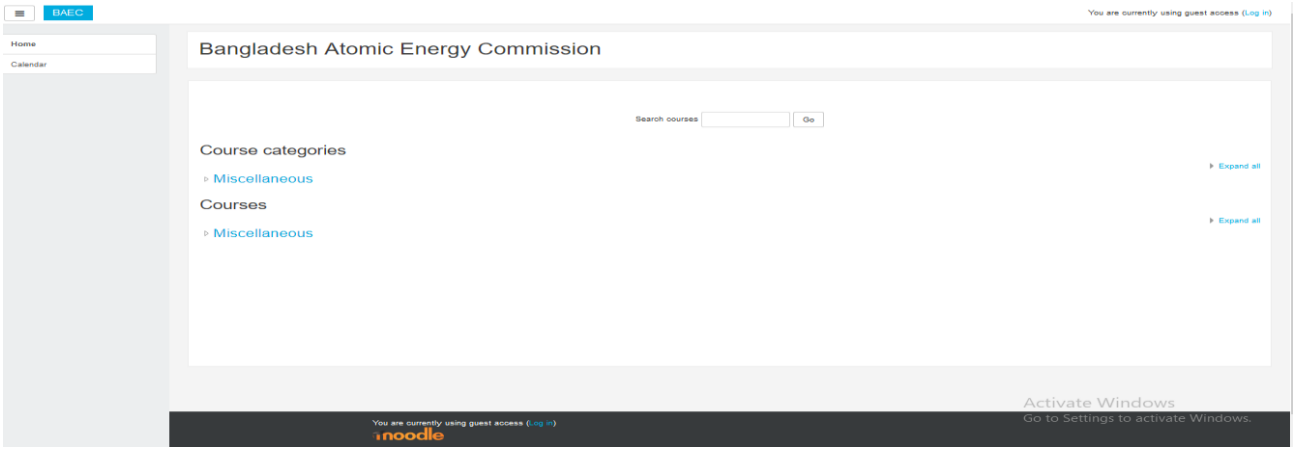


Fig: Moodle Based E-Learning Management System at BAEC

A full basis working activities like coursed in different areas will be offered and thought in future. Working progress are going on.

1.3 Research on nuclear knowledge management system

M. S. Islam and M. D. Hossain

For identifying, acquiring, transforming, developing, disseminating, using, sharing, and preserving knowledge, relevant to achieving specified nuclear knowledge and by a Computer based automation will be helpful for the development for the nuclear knowledge for the BAEC.

Fig: Nuclear Knowledge Management

Documentation in this area and Research are in progress.

1.4 Research on digital control system security and information and computer security.

M. S. Islam and M. D. Hossain

As a multidisciplinary organization, BAEC's many institutes produces mamny valuable research properties that should be reserved. On computer application level much important information are kept. It is very urgent to keep or maintain research how to save these valuable properties under all time protection and monitoring. Hence, research is very important for ensuring computer security. The researches are covering physical protection system and maintain information and computer security within a large scale. Research on this field and working activities are going on.

1.5 Design, development and expansion of data center in BAEC

M. S. Islam and M. D. Hossain

Establishment and development of Data center at BAEC, HQ is currently going on. At this data center Infrastructure development of hardware level, Network Server Installation and maintenance is going on.

Software level working is going on for different purpose to make easier the different official system like pay roll management system of BAEC HQ. This data center is very important for the commission to digitalize the commission activities.

1.6 Implementation and administration of e-nothi system at BAEC for digitalization of manual nothi system

M. S. Islam and M. D. Hossain

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

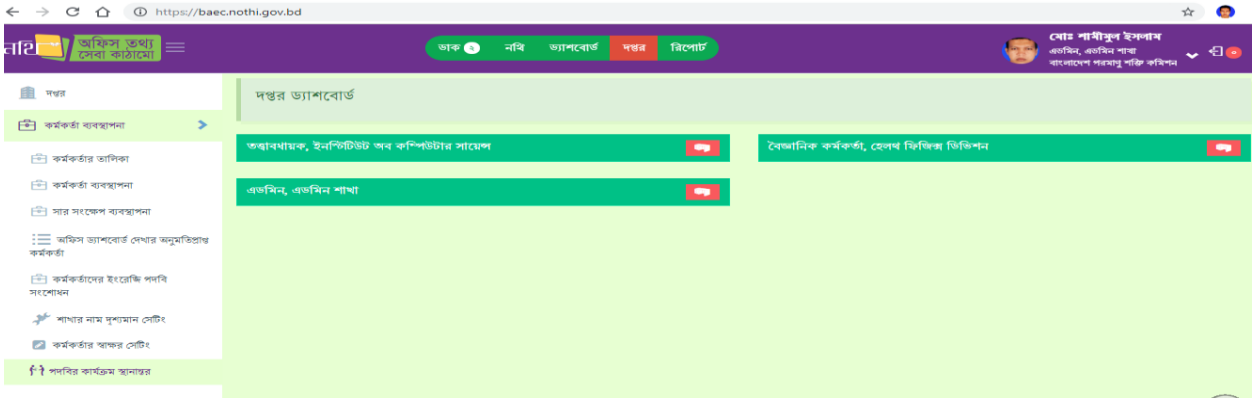


Fig. Administration Panel Of BAEC E-Nothi System

Computer System and Network Division, ICS

Objective/Introduction

Computer System and Network Division (CSND) is the division of institute of computer science (ICS). CSND is mainly responsible for designing, implementing and managing the network of CSND. CSND is to provide services and conduct basis & applied research in the field of computer science & engineering and ICT education. CSND Publishes articles in the journal as well as it provides to BAEC, such as identity card (ID) prepared for BAEC employees/students/visitors and computer hardware/software installation/ maintenance & troubleshooting and development/up-gradation of network infrastructure of BAEC, broadband/Wi-Fi internet service, 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/Program(s)

1. Research and Development Work(s)

1.1 Up-grade design and deployment of local area network of 100 Mbps bandwidth implement of BAEC head quarter, Dhaka

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

ISP provides high speed internet communication. To fulfill the current requirements of BAEC considering its smooth operation of high speed internet service, optical fiber based network is the state-of-the-art network solution. An optical fiber network design refers to the specialized processes leading to a successful installation and operation of a fiber optic network which includes determining the type of communication system(s) which will be carried over the network. We consider actual component selection, placement, installation practices, testing, troubleshooting and network equipment installation and startup. Finally, we consider documentation, maintenance and planning for restoration in event of an outage. Existing local area network (LAN) consists of computer network that interconnects computers situated in different buildings at

BAEC using network media. Inside LAN, our employees are offered a computer network design applying metallic structured cabling CAT-6. This cabling enables data transfer up to 100Mbps. The network backbone is then customized using optical links. We perform dimensioning of active elements, such as switches and routers, to ensure their margin was sufficient to meet our data throughput 500Mbps rate requirements. We provide 100Mbps internet bandwidth from BD Com Online Limited for high speed broadband internet services. Planning the route of optical fiber from BD Com Online Limited to BAEC to determine exactly where the cable plant and hardware will be located having decided to use fiber optics and chosen equipment appropriate for the application. As every installation is unique, the actual placement of the cable plant is determined by the physical locations from BD Com Online Limited to BAEC campus along the route. The route distance is around 1000 meter and we deploy the cable in the underground/overhead. Furthermore, as always premises and outside plant installations are different so we consider them separately. Finally planning for the deployment is a critical phase of any work as it involves coordinating activates of many people. We develop a checklist based on the design path for smooth installation.

1.2 LAN design and network devices cisco router, mikrotik router, manageable switch installation at of BAEC head quarter, Dhaka

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

In oder to design and build a well secured network, many factors must be taken into consideration, such as the topology and placement of hosts within the network, the selection of hardware and software technologies, and the careful configuration of each component. We have an examination of some of the issues in designing a secure Local Area Network (LAN) and some of the best practices suggested by security experts and discuss securing a LAN from the viewpoint of the network architect considering three main areas: the network topology which comprises the physical and logical design of the network; securing the routers and switches which connect segments and hosts to form the network; and, finally, some of the emerging and advanced techniques in network security will be examined. When we talk about networks, we need to keep in mind three concepts, distributed processing, network criteria and network structure. The internet is a structured, organized system. The LAN of BAEC interconnects more than 200 computers/Wi-Fi user using various network media. The previous LAN was not properly working; as a result the internet service was interrupted. Hence, the previous LAN was redesigned and up gradated using network devices Cisco Router, MikroTik Router, Manageable Switch installation currently, internet service is smoothly running at BAEC.

1.3 Up-grade design and deployment of local area network of 200 Mbps bandwidth implement of AERE, Savar, Dhaka

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

ISP provides high speed internet communication. To fulfill the current requirements of AERE considering its smooth operation of high speed internet service, optical fiber based network is the state-of-the-art network solution. An optical fiber network design refers to the specialized processes leading to a successful installation and operation of a fiber optic network which includes determining the type of communication system(s) which will be carried over the network. We consider actual component selection, placement, installation practices, testing, troubleshooting and network equipment installation and startup. Finally, we consider documentation, maintenance and planning for restoration in event of an outage. Existing local area network (LAN) consists of computer network that interconnects computers situated in different buildings at BAEC using network media. Inside LAN, our employees are offered a computer network design applying metallic structured cabling CAT-6. This cabling enables data transfer up to 200Mbps. The network backbone is then customized using optical links. We perform dimensioning of active elements, such as switches and routers, to ensure their margin was sufficient to meet our data throughput 500Mbps rate requirements. We provide 100Mbps internet bandwidth from Aamra Networks Limited for high speed broadband internet services. Planning the route of optical fiber from Aamra Networks Limited to AERE to determine exactly where the cable plant and hardware will be located having decided to use fiber optics and chosen equipment appropriate for the application. As every installation is unique, the actual placement of the cable plant is determined by the physical locations from Aamra Networks Limited to AERE Campus along the route. The route distance is around 1000 meter and we deploy the cable in the underground/overhead. Furthermore, as always premises and outside plant installations are different so we consider them separately. Finally planning for the deployment is a critical phase of any work as it involves coordinating activates of many people. We develop a checklist based on the design path for smooth installation.

1.4 LAN design and network devices cisco router, mikrotik router, manageable switch installation at Atomic Energy Research Establishment (AERE) Savar, Dhaka

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

The internet is a structured, organized system. Each network requires a structured planning and designing before deployment it that requires internet access, Internet connectivity factors should be included into the plan, Includes a practical design of network internet connectivity backbone. Procedures of selecting equipments are added and planning designs their networks. The LAN of AERE interconnects more than 550 computers/ Wi-Fi user using various network media. The previous LAN was not properly working; as a result the internet service was interrupted. Hence, the previous LAN was redesigned and up gradated using network devices Cisco Router, MikroTik Router, Manageable Switch installation currently, internet service is smoothly running at AERE. LAN Networking at AERE smoothly installed. We are expected to have a concept to any of the common Linux operating systems. Every network requires a regular maintenance such as storage maintenance, remote resource access, user management, log management and some other management. Monitoring is a regular task for all network system. It is mandatory when the system is dedicated to public service to make a user friendly and dependable monitoring system. As a result of this LAN network, Atomic Energy Research Establishment of Savar, Dhaka (AERE) is getting a high speed internet service.

2. Repair, Maintenance, Assemble and Troubleshooting

A number of new Computers Hardware/Software have been assembled/Installation for ICS as wel as other Institute of BAEC

Name of the institute	No. of PC
Institute of Food and Radiation Biology (IFRB) ,Savar	06
Institute of Computer Science (ICS) ,Savar	10
Central Engineering Facility (CEF) ,Savar	05
Nuclear Mineral Unit (NMU) ,Savar	04
Central Administrative Division (CAD) ,Savar	03
Central Finance & Accounts Division (CF&AD) ,Savar	04
Scientific Information Unit (SIU) ,Savar	01
Institute of Radiation & Polymer Technology (IRPT) ,Savar	02
Training Institute (TI), Savar	02
Institute of Electronics (IE)	01
Institute of Nuclear Science and Technology (INST),Savar	01
Tandem Accelerator Facilities Division (TAFD)	03
HQ, General Provident Fund (GPF)	02
HQ, Transport	01

3. Preparation of ID Card

Name of the institute	No. of card
Institute of Nuclear Science and Technology (INST),Savar	23
Institute of Food and Radiation Biology (IFRB) ,Savar	21
Institute of Electronics (IE) ,Savar	09
Institute of Computer Science (ICS) ,Savar	12
Central Engineering Facility (CEF) ,Savar	04
Nuclear Mineral Unit (NMU) ,Savar	02
Central Administrative Division (CAD) , Savar	24

Name of the institute	No. of card
Central Finance & Accounts Division (CF&AD) , Savar	08
Daily Basis Employee, AERE ,Savar	09
Student, AERE, Savar	50
Atomic Energy Center, Dhaka	15
BAEC Head Quarter, Dhaka	31
Center for Research Reactor (CRR) ,Savar	05
Scientific Information Unit (SIU) , Savar	01
Institute of Radiation & Polymer Technology (IRPT) ,Savar	03
Institute of Nuclear Medicine & Ailed Sciences (INMAS),Dhaka	05
Centre for Nuclear Medicine & Ultrasound (INMAS) Rajshahi	04
Nuclear Medical physics	24
Energy Institute	01
Beach Sand Minerals Exploitation Center(BSMEC) Cox"Bazar	01
Total	252

4. Network Services

773 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 given below:

Name of the institute/division/unit/auditorium/hostel/etc	No. of job
Institute of Nuclear Science and Technology (INST),Savar	141
Institute of Food and Radiation Biology (IFRB), Savar	58
Institute of Electronics (IE), Savar	06
Institute of Computer Science (ICS), Savar	05
Central Engineering Facility (CEF) ,Savar	17
Institute of Nuclear Mineral (INM), Savar	12
Central Administrative Division (CAD), Savar	16
Institute of Energy Science (IES)	03
Scientific Information Unit (SIU) , Savar	13
Institute of Radiation & Polymer Technology (IRPT) ,Savar	25
Institute of Tissue Banking and Biomaterial Research (ITBBR)	30
Centre for Research Reactor (CRR)	02
Training Institute (TI)	28
AERE Colony / Officers Hostel	55
BAEC Head Quarter, Dhaka	242
Atomic Energy Center, Dhaka	121

Software Engineering Division, ICS

Objective/Introduction

The Software Engineering Division (SED) 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/Program(s)

1. Research and Development Work(s)

1.1 Coding up-gradation to maintain seniority and interface up-gradation of 'directory of personnel'

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

BAEC maintain an employee database where all scientists, Engineers, Doctors and Geologists are on recorded according to institute. Newly appointed employees are added on the database and any up-gradation process is done in the nick of time.

An Employee database is an internet based system and is a set of information kept about employees of the organization. As a digital filing cabinet to store employee data including name, job position, hire date or date of promotion, birth date, address, and contact information.

The system will ensure that an appropriate data is collected from the various sources. The system is expected to fulfill the information needs of an individual, a group of individuals, an institute or a division of BAEC.

There was a lagging on the previous version of "Directory of Personnel" where employee can't be shown according to seniority. Now it is overcome this lagging to maintain seniority list by providing some information like joining date, batch merit position and promotion date.

1.2 Content management, customization, maintenance, up-gradation of official web portal of BAEC

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

A content management system (CMS) is a software application or set of related programs that are used to create and manage digital content.

The website of BAEC is to reflect the activities of different institutes in Bangla as well as in English. All types of up-gradation like notice board, NOC, Transfer order, Recruitment Result, 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 of different institutes/divisions of BAEC.

Web portal of BAEC is familiar with frequently content up-gradation. ICS concerned about the customization, maintenance, content up-gradation of official web portal of BAEC. Any kind of official notice is uploaded on time.

1.3 Design and development radiation monitoring system

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

Radioactive contamination into the environment particularly atmosphere is one of the major concern issue to the world nuclear research communities. Both natural and artificial radioactivity may contribute to contaminate the atmosphere. The radioactivity contamination is strictly controlled to protect the environment and to ensure that the people who may be exposed. Because people are considered to be the ultimate sufferer through radiation. The presence of the radioactivity in the atmosphere has a direct impact on peoples' respiratory system, while indirect contamination occurs by consumption through the food chain. The ill-effects of radioactive pollution are numerous. Radiation can cause cancers, abnormal births, skin diseases and mutations in man. Chronic exposure to radiations leads to leukemia in an individual and even affects an unborn child in the womb.

To address the above mentioned issues, we are going to design and develop a radiation monitoring system that may include radioactivity data acquisition and computational system which will automatically acquire radioactivity data from the atmosphere around the radiological facilities and store these acquired data into a data base. An automated computational system will compute the acquired data to detect as well as to produce various reports of radioactive also in real time. Additionally, this system will have an emergency safety notification system which will generate safety alarm if any critical condition or radiological hazards/disasters occurred.

1.4 Real-time display system to monitor plasma shape and position during the discharge of the Tokamak

M. M. Alam, M. D. Hossain and M. S. A. Chowdhury

A novel, efficient and precise real-time display system to monitor the plasma shape and position during the discharge of the tokamak has been offered in this study for the observation of the continuous behavior of the plasma that is produced inside the vacuum vessel. The observed behavior of the plasma can provide indications for the control and operation of the tokamak to achieve long time discharge. The display system can display the plasma cross-sectional view of the last closed flux surface (LCFS) with the position of the vacuum vessel wall and the X-points position with the setting of the divertor plates at a big screen in real-time.

The display system offers not only the visual image of the plasma but also time evolution graphs of various plasma parameters such as the plasma current (IP), poloidal field coils currents (IPF), emission of Hα, transport of the oxygen impurity, major radius (R), minor radius (a), plasma elongation (κ) and triangularity (δ) in real-time. For the remote participation to the experiments, the display system has a subsystem that can record the entire display frame and the time evolution graphs of the various plasma parameters as video files. The recorded video files are accessible through online by the remote participants during the operation of the tokamak. In addition, the display system has an emergency safety notification system that can identify the critical condition of the tokamak during its operation and can notify the occurrences of any critical or abnormal situations by generating an alarm. The overall display system and its subsystems have been designed and integrated with the real-time hardware equipment of the National Instruments Corporation (NI) and the entire data acquisition and computational systems have been developed by the LabView programming Language.

2. Manpower Development

Title of the event	Date	Place	No. of participant
Seminar on Cyber Security and Challenges: BAEC Perspective	09 Ja 2018	ICS, AERE	25
E-Nothi Implementation Related Training at BAEC	19-22Feb. 2018	BAEC HQ	20
Industrial attachment training program based on computer science	3 Feb. 2019 to 29 Apr. 2019	ICS, AERE	38
E-Nothi Implementation Related Training at BAEC	22-26 Jul. 2018	BAEC HQ	20
Nuclear Cyber Security Awareness Related Training Program- 2018	12-13 Nov. 2018	ICS, AERE	21

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

Name of the participant	Title of the event	Organizer	Date	Place
Dr. M. D. Hossain	International Conference on the Security of Radioactive Material: The Way Forward for Prevention and Detection	IAEA	3-7 Dec. 2018	Vienna Austria
	International Conference on Quality, Leadership & Management in the Nuclear Industry - 15th FORATOM—IAEA Management Systems Workshop	IAEA	16-19 Jul. 2018	Ottawa, Canada
	International Symposium on Communicating Nuclear and Radiological Emergencies to the Public	IAEA	1-5 Oct. 2018	Vienna Austria
	International Conference on Electronics and ICT	Bangladesh Electronics Society	25-26 Nov. 2018	Dhaka, Bangladesh

Name of the participant	Title of the event	Organizer	Date	Place
Dr. M. M. Alam	6th Workshop on Collaborative Scientific Software Development and Management of Open Source Scientific Packages.	ICTP and Sharif University of Technology, Iran	28 Apr. - 9 May 2018	Tehran, Iran.
	Plenary Meeting of the Network on Environmental Management and Remediation (ENVIRONET)	IAEA	30 Oct. - 1 Nov. 2018	Vienna. Austria.
	Technical Meeting on Conducting Computer Security Assessments	IAEA	12 -16 Nov. 2018	Daejeon, Korea
	12thDigital Service Design Lab	A2I, MoST	6-11 Jan. 2019	AERE, Savar
M. N.Nobi	Refreshers Training of e-Nothi Admins	A2I and ICTD	3 to 4 Jun. 2018	Dhaka, Bangladesh
M. A. Habib	Reactor Engineering Course at BAEC (RECB-6)-2018	TI, BAEC	10 Feb. - 01 Mar. 2018	TI, AERE, Savar
N. K. Datta	Basic Nuclear Orientation Course (BNOC)-2018	TI, BAEC	01 Apr. – 31 May18	TI, AERE, Savar

4. Others

- Dr. Md. Mahbub Alam has been provided IT Consultency and Expert IT Service as per Govt. demand at the "13th Digital Service Design Lab (DSDL)" from 3-8 February, 2019, Organized By: Ministry of Religious IT Consultency and Expert IT Service as per Govt. Demand: Affairs & a2i, ICT Division
- Dr. Md. Mahbub Alam has been provided IT Consultency and Expert IT Service as per Govt. demand at the "14th Digital Service Design Lab (DSDL)" from 24 February-1 March, 2019, Ministry of Food & a2i, ICT Division
- Works as an international Peer-reviewer

5. Service Renderd

Name of service	No./quantity of sample
BAEC Domain based Official Email Services	450 active users/running
Management Information System Administration Services	2200 active users/running
E-Nothi Administration Services	142 active users/running
Consultation to the Scientists on the Computer and ICT	200/running
Wi-Fi Internet Security Services	200/running

INSTITUTE OF ENERGY SCIENCE (IES), AERE

Objective/Introduction

Bangladesh Atomic Energy Commission is struggling on reinforcing its culture of innovation with un-relented commitment to face the energy challenges of Bangladesh in the new millennium. Energy is the strategic input for sustainable development and the issue of energy security is considered like the individual security, social security and territorial security. Institute of Energy Science, the newly established institute in the Atomic Energy Research Establishment has been started functioning in 3 April 2008 to build a favorable infrastructure for sustainable energy research and to promote the technological know-how in both renewable and non-renewable energy fields. The planned research and development activities are diverse and broad and the main objectives are to

- build trained and skilled manpower in different areas related to energy production
- undertake and promote R&D activities in the respective fields
- develop new technology for efficient and cost-effective energy production

- perform R&D in renewable sources, including hydrogen energy support academic activities, such as M.Sc., M.Phil., Ph.D. studies and carry out collaborative research programs

Activities/Program(s)

1. Research and Development Work(s)

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

2. Collaboration Work(s)

- S &T Project: Special allocation project for Ministry of Science and Technology entilted

  Radiological Consequence Analysis due to Accidental Release of Radioxenon from TRIGA Research Reactor is under completion
- IAEA TC Project: "Strengthening Capacity in the Design and Development of Spent Fuel Storage and the Reactor Safety Testing Laboratory (BGD/1013)" is on-going

INSTITUTE OF RADIATION AND POLYMER TECHNOLOGY (IRPT), AERE

Objective/Introduction

- Application of radiation processing technologies for the socio-economic development of the country
- Providing commercial gamma irradiation services for quality improvement of food items and sterilization of medical products, pharmaceutical raw and packaging materials etc.
- To provide irradiation service to research organizations for R & D purpose
- To expand cooperation with other scientific organizations, universities, private and public sectors through mutual exchange of educational programs, training, technical cooperation and expert services
- To develop human resources in the field of nuclear science and technology
- Transferring the technology to the entrepreneurs for industrial applications
- Preparation of hydrogel for biomedical application and heavy metal removal
- Construction of dye sensitized Solar Cells (DSSCs) with TiO_2 and ZnO nanoparticles and the effect of gamma (γ) radiation on them was determined

Activities/Program(s)

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 ofRadiation. Variousnatural 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 werecarried out and comparative study between hand Lay-up and Compression Molding Technique wereconducted. Impact of sand on mechanical properties of Jute Fabrics Reinforced Polypropylene based composite has been determined. Fabrication and characterization of Carbon Kevlar Reinforced Polypropylene based composites were done. Physico-mechanical property of unidirectional Jute Fiber Reinforced Polypropylene and Linear Low-Density Polyethylene based composite weredetermined and impact of dyeobserved.

1.2 Use of radiation, chemical and microbiological tools for water treatment for different uses

Physico-chemical and microbiological quality assessment of surface water of Turag river, Buriganga river and different aquaculture pond inSavar, Dhaka were conducted. Gamma irradiation was used for the treatment of polluted river water. Research was conducted to investigate naturally occurring bacterial strategy in degrading or detoxifying heavy metals of the Buriganga River. Study was conducted in a view to removal of chromium and lead from paint industry effluent by naturally occurring bacteria. Biodegradation capability of pesticide resistant naturally occurring bacteria to breakdown the hazardous residual pesticide was also observed.

2. Repair & Maintenance and Renovation Works

Mechanical problem of IRPT Co-60 Gamma plant was resolved and plant started working properly.

Demineralize water treatment plant was installed for IRPT Gamma source. The capacity of water treatment plant is 1000L/hr.

A process controller was installed for Twin Screw Extruder Machine of IRPT.

Repair and maintenance work was done for Heat Press Molding Machine of Composite Lab of IRPT. Hydraulic O ring, gasket, pressure bucket, hydraulic oil, hydraulic jack was replaced.

3. Manpower Development and Training Program

Date	Title of the event	speaker	Place	No. of participant
11/03/2019	Development of biodegradable films	M. Z. I. Mullah	IRPT, AERE	20
19/03/2019	Jute based composite materials	M. B. Uddin	IRPT, AERE	15
25/03/2019	Prospects of biodegradable materials	M. Razzak	IRPT, AERE	15
11/02/2019	Research on Gamma Radiation at IRPT	Dr. R. A. Khan	IRPT, AERE	20
18/02/2019	Application of composite materials.	M. B. Uddin	IRPT, AERE	15
25/02/2019	Research of pool water of the plant, IRPT	M. S. Manir	IRPT, AERE	15
14/01/2019	Innovation	Dr. R. A. Khan	IRPT, AERE	20
21/01/2019	Characterization of composite materials	M. B. Uddin	IRPT, AERE	15
28/01/2019	Research of pool water of the plant, IRPT	M. S. Manir	IRPT, AERE	15
10/12/2018	Fabrication of composite materials	M. B. Uddin	IRPT, AERE	20
18/12/2018	Category of Radioactive sources	M. Razzak	IRPT, AERE	15
24/12/2018	Water Analysis	M. S. Manir	IRPT, AERE	15
13/11/2018	Nuclear Grade Water	Dr. R. A. Khan	IRPT, AERE	20
19/11/2018	Research Methodology	Dr. A. K. M. Alam	IRPT, AERE	15
28/11/2018	Equipment of IRPT	M. B. Uddin	IRPT, AERE	15
8/10/2018	Radiological Accident	M. B. Uddin	IRPT, AERE	20
15/10/2018	Environmental Radioactivity Monitoring	M. Razzak	IRPT, AERE	15
24/102018	Characterization of Polymer	M. Z. I. Mullah	IRPT, AERE	15
11/09/2019	Radioactive Materials	Dr. R. A. Khan	IRPT, AERE	20
17/09/2019	Radioactive source protection	M. Razzak	IRPT, AERE	15
24/09/2019	Security system of radioactive plants.	M. B. Uddin	IRPT, AERE	15
13/08/2018	Gamma Radiation and its application	Dr. R. A. Khan	IRPT, AERE	20
14/08/2018	Application of natural polymer as growth promoter.	M. Z. I. Mullah	IRPT, AERE	15
29/08/2018	Overview of Radiation, protection and control	M. B. Uddin	IRPT, AERE	15

4. Lecture Delivered

Title of the event	Duration	Venue	Lecture topic	Lecturer
MIST-Nuclear Chemical Engineering Corrosion Sessional	18 Hours	IRPT, AERE	FTIR, UTM, Nuclear Grade Water, Co-60 Gamma Source, Biomaterials, Nanomaterials.	Dr. R. A. Khan, Dr. M. Alam, Z. I. Mollah, M. Razzak
JU- In-plant Training	01 Month	IRPT, AERE	FTIR, UTM, Nuclear Grade Water, Co-60 Gamma Source, Biomaterials, Nanomaterials.	Dr. R. A. Khan, Dr. M. Alam, Z. I. Mollah, M. Razzak
DUET-Industrial Attachment	03 Weeks	IRPT, AERE	FTIR, UTM, Nuclear Grade Water, Co-60 Gamma Source, Nanomaterials, Nuclear Reactor Engineering.	Dr. R. A. Khan, Dr. M. Alam, Z. I. Mollah, M. Razzak

5. Seminar/Symposium/Conference/Meeting Attended

Name of participant	Title of the event	Organizer	Date	Place
Dr. R. A. Khan	The transportation security for radioactive materials	Department of Energy, USA.	13-16 May 2019	Oakridge National Laboratory, Tennessee, USA.
M. Razzak	Regional Training Course on Multivariate Data Analysis Using the Chemometrics Add-in for Microsoft Excel including DD-SIMCA	Zhejiang Academy of Agriculture Science, China and IAEA.	15-19 Apr. 2019	Hangzhou, China.
M. S. Manir	KAERI-IAEA Nuclear Knowledge Management	KAERI-IAEA	24-28 Jun. 2019	Daejeon, Korea

6. Stakeholder Seminar/Meeting Arranged

Several stakeholder meetings were held with different company e.g. Pran Agro Ltd., Square Food and Beverage Ltd., DDRM etc. for promoting irradiation services to these stakeholders between July 2018 to June 2019 at IRPT.

7. 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 takefood 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.

No. of service given to the organization	Nature of sample /service	Quantity of sample	Income
53 consignment (10 companies)	Food irradiation	126.04 Ton	49,26,286/-
2 consignment	Medical products	164.00 CFT	65,600/-
Total			49,91,886/-

INSTITUTE OF NUCLEAR MINERALS (INM), AERE

Introduction

INM was mainly engaged in nuclear mineral exploration program in the north-eastern part of Bangladesh. This institute was also involved in coal seam delineation as well as groundwater aquifer studies in different parts of Bangladesh. In addition, this institute provided geophysical borehole logging services as per demands of different organizations/companies.

Activities/Program(s)

1. Research and Development Work(s)

1.1 Estimation of Radon concentration in groundwater samples at the coastal areas of Bangladesh

M. Z. Kabir, F. Deeba, M. G. Rasul, M. I. Khalil, R. K. Majumder, M. S. Islam and T. S. Dina

Radon is a radioactive noble gas, occurring in varying concentrations practically everywhere. It has a half - life of 3.82 days. Radon is extremely volatile and is readily released from water. Radon gas can also dissolve and accumulate in water until it aerates. In the present investigation, analysis of radon concentration in 15 water samples collected from different locations of Cox's Bazar district of Bangladesh has been carried out by using Alpha Guard PQ2000 PRO (Saphymo, Germany) radon monitor. The measured radon concentration in water samples lies in the range from 0.36 to 15.68 Bq l^{-1} with the mean value of 4.22 Bq l^{-1} . To develop a baseline database for increase awareness and mitigate possible hazards, radon concentration in groundwater in the coastal area of Bangladesh (Cox's Bazar district) has been estimated.

1.2 Geochemical characterization and heavy mineral distribution of sediments from Moheshkhali Island of the eastern Bay of Bengal, Bangladesh

F. Deeba, M. Z. Kabir, M. G. Rasul, R. K. Majumder, M. I. Khalil, N. T. Dina and M. S. Islam[1]

The Moheshkhali Island is located at the eastern region of the Bay of Bengal. The investigated island is mainly initiated by the combined erosional and depositional processes on an open to semi protected depositional basin under the transgressive shore face. The study presents the geochemical characterization, heavy mineral distribution and their potential provenance identification. Samples were collected from 5 ft below the suface of the island. The heavy mineral concentration in different raw sand sample resulted from Heavy Liquid Separation technique revealed that the average abundance of heavy minerals is 9.32% in Moheshkhali Island of recent beach deposition. The concentration of Na_2O, MgO, Al_2O_3, SiO_2, P, K_2O, CaO, TiO_2, V_2O_5, Cr_2O_3, MnO, Fe_2O_3, CoO, ZnO, SrO, Y_2O_3 ZrO_2, Nb_2O_5, MoO_3, HfO_2, WO_3, ThO_2, U_3O_8, CeO_2, Nd_2O, Er_2O_3 in collected samples were determined by X-ray fluorescence spectrometry study.

1.3 Borehole geophysical logging for groundwater aquifer delineation and water quality assessment at Dhaka City, Bangladesh

M. I. Khalil, M. G. Rasul, R. K. Majumder, M. Z. Kabir, F. Deeba, M. S. Islam and T. S. Dina

Geophysical loggings using gamma, SP and resistance tools were performed in three Production Tube-well (PTW) boreholes located at Kwalar, Khilkhet and Sritidhara, Kadamtali of Dhaka city to determine the subsurface layer properties and to delineate the potential aquifer zones from the sub surface layers. From Gamma, Self Potential (SP) and Single Point Resistance (SPR) logs groundwater aquifers were delineated and water quality was assessed. 35-80 cps gamma values, positive SP deflection and 120-280 Ω resistance values delineate two aquifers in the area. The upper aquifer lies at 38-138 meters depths while lower aquifer lies at 107-186 meters depth. Positive deflection of SP curve and resistance values represent that both upper and lower aquifers contain fresh water.

2. Collaboration Work/MoU

Under the special allocation of the Ministry of Science and Technology for the Financial Year 2018-2019, project titled "Analysis of Natural Radioactivity and Radon Concentration in Groundwater from Sandstone Aquifer of Maddhapara Hard Rock Mining Area, Dinajpur, BangladeshÓ has successfully been completed.

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

Name of the participant	Title of the event	Organizer	Date	Place
Dr. R. K. Majumder	Radioactive Minerals production, waste management and environmental Remediation after uranium mining operation	IAEA	29 Oct. -23 Nov. 2018	Czech Republic
	Electronic Government Procurement (e-GP) System	TI, AERE	31 Mar. - 04 Apr. 2019	Dhaka
M. I. Khalil	Disposal of radioactive waste	IAEA	06-10 Oct. 2018	Iran
M. Z. Kabir	Electronic Government Procurement (e-GP) System	TI, AERE	31 Mar. - 04 Apr. 2019	Dhaka
N. T. Dina	Nuclear and Radiological Emergency Preparedness	TI, AERE	25 Nov. – Dec. 06, 2018	Dhaka
	Basic nuclear orientation course	TI, AERE	09 Sept. - 11 Nov. 2018	Dhaka
	Nuclear cyber security awareness	Dhaka	12-13 Nov. 2018	Dhaka

4. Service Rendered and Revenue Income

Name of service provided	Nature of service	Total no.	Income
Borehole geophysical logging service for groundwater quality assessment and aquifer studies	Spontaneous Potential, Electric, Resistivity, Gamma	5	1,75,000/-
Borehole geophysical logging service for groundwater quality assessment and aquifer studies	Spontaneous Potential, Electric, Resistivity, Gamma	7	2,10,000/-
Borehole geophysical logging service for groundwater quality assessment and aquifer studies	Spontaneous Potential, Electric, Resistivity, Gamma	1	35,000/-
Borehole geophysical logging service for groundwater quality assessment and aquifer studies	Spontaneous Potential, Electric, Resistivity, Gamma	1	35,000/-
Total		14	4,90,000/-

NUCLEAR MEDICAL PHYSICS INSTITUTE (NMPI), AERE

Objective/Introduction

Cancer is a serious health problem in Bangladesh which is expected to double in the next 10 to 20 years. Nuclear technology is being used to diagnose and treatment of a huge number of patients with cancer. Medical Physicists play a vital and often leading role on the management of patients with cancer. Medical physics professionals and nuclear medicine technologists are currently in high demand not only in Bangladesh but also in many developed countries. Due to lack of well-qualified medical physicists and nuclear medicine technologists, the Institute of Nuclear Medical Physics has been established through a development GoB fund. Currently, the Institute has been run by a similar nature ADP project. The prime objectives are:

- To provide cancer detection and treatment services 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 in order to clinical use, training and multidisciplinary research.

Activities/Program

1. Research and Development Work(s)

Dosimetric characteristics of medical linac

M. M. Ahasan, N Sultana, A. N. Monika, R. Alam, J. Hossain, A. Hasnath, S. Sultana, M. B. Paul, F. U. Uddin S. Akter R. Khatun and R. P. Das

The dose rate for the BAEC Linac is 1.0 cGy/MU for a 10 x 10 field size defined at the isocenter. Absorbed dose is measured at a specific point in a medium and refers to the energy deposited at that point. Depth is Distance beneath the skin surface where the prescribed dose is to be delivered. The distance from the source of photons to the isocenter is called SSD. In SSD, Isocenter established at the patients skin surface, When the gantry rotates around the patient, the SSD will continually change and Dose calculations often at DMAX. In SAD, Isocenter established within the patient. The SAD and the isocenter are at a fixed distance and therefore do not change. The intersection of the axis of rotation of the gantry and the axis of rotation of the collimator for the treatment unit is called isocentre. In SSD, field size set on the collimator will be the same measured at the patients skin and in SAD, the field size set inside the patient (size measured on patients skin will be smaller). Output of a machine is the amount of radiation exposure produced by a treatment machine or source as specified at a reference field size and at a specified reference distance.

2. Service Rendered and Revenue Income

Name of the service	Quantity	Income
2D/3D CRT Exposure	5220	60,00,000/-
IMRT Exposure	1430	
TPS Planning	212	
CT Simulation	218	
PET-CT Scan	201	
Cancer Patient services per day (av.)	30	
Total		60,00,000/-

BEACH SAND MINERALS EXPLOITATION CENTRE (BSMEC), COX'S BAZAR

Objective/Introduction

Study on heavy minerals at the coastal and fluvial environments of Bangladesh; marine environmental radioactivity and trace metal monitoring and measurement in sediments and sea water. Following specific programs are being carried out to fulfill the major objectives.

- Exploration for economic placer minerals in the coastal and fluvial depositional environments of Bangladesh
- Routine laboratory and plant processing of placer sands
- Comparative study on the occurrence, distribution, mineral composition and characteristics of heavy and radioactive minerals from coastal and fluvial environments of Bangladesh
- Effect of heavy mineral deposits on ground water quality along the southeastern coast of Bangladesh
- Determining radionuclides and trace elements in the sediments and seawater of southeast coast
- Study on marine and coastal environmental radioactivity

Activities/Program(s)

1. Research and Development Work(s)

1.1 Economic mineral exploration in fluvial depositional areas of Bangladesh

M. Rajib and M. F. Hossain

Geological field survey was carried out at Gorai River, a major tributary of the River Padma in Kumarkhali Upazila, Kushtia Districts for the exploration of economic minerals in fluvial environment. Gorai River is under dredging project for last several years for the suitable navigability. However, after dredging, the sands

from the middle of the river are kept just on the bank. Therefore, survey was conducted to identify any economic minerals present in the dredged materials. A total length of 15 kilometer area was surveyed along the river to collect of approximately 350-kilogram bulk sand from 5 sampling locations. Auger sampling technique was adopted to collect a mixture of 5-feet column sand at each location. Bromoform separation technique will be applied for quantification of heavy minerals and thereafter identification by microscopic grain counting to conclude about the potential reserve estimation of economic minerals present in the dredged materials of Gorai River sediments. A collaborative research work is being going on with Department of Geological Sciences, Jahangirnagar University.

1.2 Separation of river born silica for potential application in glass making

M. Rajib and M. F. Hossain

River born bar sediment were used to identify the potentiality of economic utilization. Raw sand samples were collected from the dredged materials of Gorai River. Appx. 350-kg sands were washed and sieved to get rid of clay particles and any unwanted materials and later run through the magnetic separator IRMS for obtaining two fractions namely magnetic and non-magnetic at specific instrumental condition. Non-magnetic fraction mostly consists of the light colored silicate minerals. Those silicate minerals are comprising of both quartz and feldspar, however, binocular microscopic observation indicates that more than 90% of the non-magnetic fraction is composed of quartz. Therefore, this fraction could be a potential alternate of the glass making sand, known as 'glass sand'.

1.3 Preparation of heavy mineral samples for potential application in thin film study

M. Rajib and M. F. Hossain

Thin film is a layer of materials ranging from fractions of nanometer to several micrometers in thickness. The controlled synthesis of the materials as thin films is a fundamental step in many applications. Synthetic magnetic, hematite, zircon, silica, etc. have wide application as thin films. However, natural placer minerals like those have not been tried to make such thin films in Bangladesh. Therefore, the objective of the present research is to prepare several minerals like magnetite, zircon and silica which can be easily separated in the laboratory of BSMEC for making thin films. A collaboration research has been initiated with the Experimental Physics Division of Atomic Energy Center, BAEC, Dhaka.

1.4 Preparation of the samples for the utilization of magnetite and ilmenite mineral for improvement of radiation shielding materials

M. Rajib and M. F. Hossain

Among the available heavy minerals in Bangladesh coast, magnetite and ilmenite is already utilized as radiation shielding materials. As continuation of previous researches of BAEC, present study was a part of attempt to prepare composite based or layer-wise radiation shielding materials. The purpose was to achieve relatively high mass attenuation coefficient by excluding the percentage of toxic lead as a matrix. For this, magnetite and ilmenite were processed in the laboratory to obtain maximum physical grade. Standard procedure using shaking table as density, IRMS as magnetic and ESPS as electric separator were used. At the same time, raw sand was also prepared through washing and sieving for the comparison. The prepared samples were then sent to INST, AERE for further study as part of a collaboration research.

1.5 Preparation of the samples for the quantification of radioactive and rare-earth elements present in the heavy placers of the Cox's Bazar coast

M. Rajib and M. F. Hossain

Heavy mineral deposits of Bangladesh at the coastal area are reported to contain several radioactive minerals, such as zircon and monazite. The presence of uranium and thorium in those radioactive minerals increases the total radioactivity in the beach environment. Specially, being the most popular tourist area of the country, Cox's Bazar coast is the center of attraction of millions of people who used to stay on or very near to concentration of heavy mineral area. Since there is a strong positive relation of radioactivity with the deposition of heavy minerals, quantification of the activity needs to be determined. In light of these, 6 samples were prepared for analysis by neutron activation analysis. The samples are- raw sands from the foreshore deposition of 2000 and 2019, separated and physically upgraded magnetite, ilmenite, garnet, rutile, zircon and radioactive concentrate majoring monazite. A research collaboration with Reactor and Neutron Physics Division (RNPD), INST, AERE has been initiated to carry out this research.

2. Manpower Development and Training Program

2.1 Arranged Training Program

Title of the event	Date	Place	No. of participants
In-house Training for BSMEC Employees (November-December, 2018)	26 Nov. -04 Dec. 2018	BSMEC	15
In-house Training for BSMEC Employees (January-May, 2019)	26-30 Jun. 2019	BSMEC	13

2.2 Attended Training Program

Name of the participant	Title of the event	Organizer	Date	Place
Dr. M. Rajib	1. Electronic government procurement (e-GP) system	BAEC	31 Mar. -4 Apr. 2019	TI, AERE
	2. Office Management and Capacity Development	Bangladesh Institute of Management (BIM)	16-17 Feb. 2019	BIM, Dhaka
	3. Joint ICTP-IAEA School of Nuclear Energy Management	The Abdus Salam International Center for Theoretical Physics	8-19 Oct. 2018	Trieste, Italy
	4. IAEA/RCA Regional Training Course on Rapid Assessment of Radionuclides in the Marine Environment	Argonne National Laboratory (ANL)	10-21 Sept. 2018	Illinois, USA
	5. a special short course on 'Achieving sustainable development goals in Bangladesh'	BPATC	1-5 Jul. 2018	BPATC, Dhaka
M. F. Hossain	1. Radiation Protection for Radiation Workers RCOs of BAEC, Medical Facilities & Industries-2018	BAEC	5-9 Aug. 2018	TI, AERE
	2. Follow-up training course (FTC) on Nuclear and Radiological Emergency Preparedness Course	BAEC	25 Nov. -06 Dec. 2018	TI, AERE
	3. Follow-up Training Course on Environmental Radioactivity Monitoring	BAEC	13- 17 Jan. 2019	TI, AERE
M. M. Islam	Office Management and Capacity Development	Bangladesh Institute of Management (BIM)	4-5 May, 2019	BIM, Dhaka
M. M. Rahman	1. Office Manners and General Behavior	BAEC	29-31 Jul. 2018	TI, AERE
	2. Office Management and Capacity Development	Bangladesh Institute of Management (BIM)	4-5 May, 2019	BIM, Dhaka
M. Y. Ali	Office Manners and General Behavior	BAEC	29-31 Jul. 2018	TI, AERE

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

Name of the Participant	Title of the event	Organizer	Date	Place
Dr. M. Rajib	Young Scientists Congress-2018	BAS	13-14 September, 2018	NSTM, Dhaka
M. F. Hossain				

4. Collaboration Work/MoU

- Joint research with Bangladesh Oceanographic Research Institute
- Joint research with *Reactor and Neutron Physics Division (RNPD), INST, AERE*
- Joint research with *Experimental Physics Division, AECD*

5. Others

5.1 Academic and industrial visit of university faculties, students and professionals

Name of the organization	Date	No. of participants
Department of Oceanography, University of Dhaka (DU)	03 Sept. 2018	40
Department of Physics, Khulna University (KU)	01 Oct. 2018	23
Dept. of Environmental Science, Jahangirnagar University (JU)	05 Dec. 2018	51
Dept. of Petroleum and Mining Engineering, Jashore University of Science and Technology (JUST)	19 Sept. 2018	36
Bangladesh Navy	29 Jul. 2018	9
Bangabondhu Sheikh Mujibur Rahman Maritime University (BSMRMU)	31 Oct. 2018	34
National Oceanographic and Maritime Institute (NOAMI)	24 Apr. 2019	18

5.2 Laboratory facilities have been provided to different research students of different universities/ institutions

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 programs, training, technical cooperation and expert services
- Develop human resources in the field of nuclear science and technology

Activities/Program(s)

1. Research and Development Work(s)

1.1 Measurement of radioactivity in imported and exportable food and allied materials

S. Hossain, A. K. M. S. I. Bhuian, N. Deb, S. Hossain, R. Talukdar, C. K. Mahmud, M. Asaduzzaman, M. Ahmed and M. A. Uddin

The objective of this program is to ensure safety of food and its allied materials from radiation contamination. Presence of radioactivity in food and related food stuffs may results severe external and internal hazard to the human health. Since Bangladesh imports high amount of food materials from other countries, it is essential to monitor the levels of radioactivity in imported/exportable food materials. Such kind of monitoring is carrying out according to NSRC Rule-1997, SRO No. 205-Law /97.

1.2 Monitoring and assessing of radiation level in marine, non-marine and coastal environment due to nuclear activities or radioactive waste disposal

Dr. S. Hossain, Dr. A. K. M. S. I. Bhuian, S. Hossain, S. R. Talukdar and M. Ahmed

The objective of this program is to protect human life, property and environment from undue radiation hazard by means of exposure control and radioactivity monitoring of the environmental elements. Different point and non-point sources existing in the environment or industries can cause radiation hazard. Establishment of base-line data for the background and other radiation sources in the country is another vital issue. Several programs would be initiated towards individual and environment monitoring and radiation safety such as radiological impact assessment of waste management and disposal practices; establishment of benchmarks for assessing the radiological impact of the nuclear power activities on the marine environment in the Asia Pacific Region and related radioecology studies, personnel monitoring services to all radiation workers and support to the regulatory authorities in assessment of genuineness of dose for overexposure situations would be provided.

Several training and certification courses in radiological physics and safety would be conducted regionally on a regular basis.

1.3 Assessment of heavy metal contamination in various bio-geo-environmental samples

Dr. S. Hossain, Dr. A. K. M. S. I. Bhuian, N. Deb, S. Hossain, C. K. Mahmud and M. Asaduzzaman

The objective of this program is to provide advanced analytical facilities to the different researchers and continue research activities to develop and establish methodologies for analyzing trace (both toxic and essential) elements in samples of different matrices. Present program is rendering analytical services to the clients and pursuing R&D activities focusing the socio-economic development of the country, especially in the field of environmental pollution such as; air, water and soil etc.

1.4 Environmental monitoring and impact assessment due to chemical and industrial hazard across the country

Dr. S. Hossain, Dr. A. K. M. S. I. Bhuian, N. Deb, S. Hossain, S. R. Talukdar, C. K. Mahmud, M. Asaduzzaman and M. Ahmed

In recent years, environmental issues are playing an increasing role in the consideration of options available for energy production. In the context of fossil power, thermal power, and nuclear power, environmental protection and public safety are inextricably linked to the setting up, operation and maintenance of the entire fuel cycle facilities. In addition, due to expanding trend of industrialization especially in the sector of garment manufacturing, textiles, fertilizer industries, chemical industries, tanneries etc. safe environment are at risk. Broadly speaking, these pertain to the protection of occupational workers, general public and the environment at large. Therefore, comprehensive research and development activities on environmental impact and risk assessment for chemical and industrial contaminants are required which will cover both meteorological and hydro-geological investigations for contaminated/non-contaminated sites. Modelling of contaminant transport and dispersion in the atmosphere and hydrosphere would be done.

2. Collaboration Work

2.1 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.)

2.2 IAEA/RCA Project - RAS/7/028

Enhancing Regional Capabilities for Marine Radioactivity Monitoring and Assessment of the Potential Impact of Radioactive Releases from Nuclear Facilities in Asia-Pacific Marine Ecosystems. (Objective: To improve the integrated regional quality-assured capabilities for marine radioactivity monitoring and for impact assessment of routine and accidental releases of radioactivity into the marine environment.)

3. Training program/Workshop/Seminar/Symposium/Conference/Study tour arranged

Title of the event	Date	Place	No. of participants
In-house Training Course	05 Sept. 2018 – 25 Jun. 2019	AEC, Chattogram	34
Annual Seminar on "Fundamentals of Radiation Dosimetry and Recent Progress on Dosimeter".	27 Nov. 2018	AEC, Chattogram.	~150
Study Tour of the Students of Department of Nuclear Science and Engineering, MIST to AECC.	06 Dec. 2018	AEC, Chattogram.	42
Study Tour of the Students of Department of Physics, CU to AECC.	06 Dec. 2018	AEC, Chattogram.	78

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

Name of the participant	Title of the event	Organizer	Date	Place
R. Roy and M. M. Huqe	Training Course on Service Mannerism & Order (6th Batch).	Training Institute, BAEC	29– 31 Jul. 2018	TI, AERE
M. Ahmed	Training Course on Radiation Protection for Radiation Workers and RCOs of BAEC, Medical Facilities and Industries-2018.	Training Institute, BAEC	05–09 Aug. 2018	TI, AERE
	Basic Nuclear Orientation Course (BNOC) – 2018 (2nd Batch).	Training Institute, BAEC	09 Sept. - 01 Nov. 2018	TI, AERE
M. M. Rahman	Training on Practical Income Tax and VAT Management.	Bangladesh Institute of Management (BIM), Dhaka	23 Sept. – 04 Oct. 2018	Bangladesh Institute of Management (BIM), Dhaka
	PPR 2008 and Annual Procurement Planning.	Bangladesh Institute of Management (BIM), Dhaka	21 – 25 Oct. 2018	Bangladesh Institute of Management (BIM), Dhaka
Ferdous Begum	Government Office Management and Skill Development.	Bangladesh Institute of Management (BIM), Dhaka	02 - 03 Nov. 2018	Bangladesh Institute of Management (BIM), Dhaka
M. Asaduzzaman	FTC on Nuclear and Radiological Emergency Preparedness Course.	Training Institute, BAEC	25 Nov. – 06 Dec. 2018	TI, AERE
Dr. A. K. M. S. I. Bhuian, S. Hossain and M. Ahmed	National Conference on Physics-2019	Bangladesh Physical Society	07-09 Feb. 2019	Department of Physics, University of Dhaka.
Dr. S. Hossain	Short Course on Project Management: Computer Based Approach.	Directorate of Continuing Education (DCE), BUET, Dhaka	22-26 Feb. 2019	BUET, Dhaka
	Electronic Government Procurement (E-GP) System.	Training Institute, AERE, BAEC.	31 Mar. 04 Apr. 2019	Training Institute, AERE, Savar, Dhaka, Bangladesh.
	IAEA/RCA Workshop on Implementation of Quality Management Systems in Radio-analytical Laboratories Involved in Marine Radioactivity Studies.	IAEA/RCA Workshop.	29 Apr. 03 May, 2019	Penang, Malaysia.
	Radioactive Material Transportation Security Training.	United States Department of Energy, National Nuclear Security Administration (DoE/NNSA)	13-16 May, 2019	Oak Ridge National Laboratory (ORNL), Oak Ridge, Tennessee, USA.

5. Stakeholder Seminar/Meeting

Title of the event	Date	Place	Short description
Stakeholder Meeting/ Public Hearing	24 December, 2018	AEC, Chattogram, Bangladesh	About 20 Importer's and C & F Agent's representative were present at the hearing. An open discussion regarding the service rendered by AECC took place in the hearing.
Stakeholder Meeting	14 February, 2019	AEC, Chattogram, Bangladesh	About 15 Importer's and C & F Agent's representative were present at the meeting. An open discussion regarding the service rendered by AECC took place in the meeting.

6. Science Fair Attended

Title of the event	Organizer	Date	Place	Short description
5th Science and Technology Fair	Divisional Commissioner Office, Chattogram.	06-07 Sept. 2018	St.Placid's School and College, Chattogram	A stall was established in the fair regarding the peaceful uses of atomic energy and safe nuclear power production. The personnel from AECC represented the various activities of BAEC and Construction of Rooppur Nuclear Power Plant Project (CRNPP) to the visitors.

7. Service Rendered and Revenue Income

Name of the service provided	No. of consignment	Income
Radioactivity testing of imported foods and allied materials	13,697	196,582,515.27
Radioactivity testing/survey of miscellaneous materials	27	131,365.00
Total	13,724	196,713,880.27

RADIATION TESTING AND MONITORING LABORATORY (RTML), MONGLA, BAGERHAT

Objective/Introduction

- Radioactivity testing of foods and other allied materials imported & exported through Mongla port
- 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. Collaboration Work/MoU

ADP Project Code: 223012100, under which RTML manpower will get professional training as part of human resource development. Also, residential accommodation facilities are going to be established

2. Repair & Maintenance and Renovation Works

- 19 AC were serviced, among which 3 repaired for their defective semiconductor control circuits and internal part fan wheel and refilled with coolant gas as per necessary
- Partial servicing of RTML from-yard fountain, full servicing with solar battery system
- Pump room floor and garage entrance slope were repaired, also, the main gate was repaired for gate wheel and sliding metallic arc.

3. Service Rendard and Revenue Income

Name of service	No. of sample	Income
Measurement of radioactivity in food	79	17,98,886/-

II. BIO-SCIENCES

INSTITUTE OF FOOD AND RADIATION BIOLOGY (IFRB), AERE, SAVAR

Agrochemical and Environmental Research Division, IFRB

Objective/Introduction

Agrochemical and Environmental Research Division (AERD) is involved in research relating to residues fate, distribution, degradation, translocation and impact of pesticides in environment and also engaged in elemental analysis and their impact on food & environment and in rendering services. The objectives are:

- To know the present status of residues of pesticides, heavy metals and trace elements in food and environment
- To generate and provide pesticide residue data for fixing National Acceptable Daily Intake (ADI) and Maximum Residue Limit (MRL) of Bangladesh
- To promote safe and effective use of pesticides for safe guarding human health and environment

Activities/ Program(s)

1. Research and Developemnt Work(s)

1.1 Identification and quantification of soil pesticides in coastal region of Bangladesh

M. A. Uddin, M. A. Z. Chowdhury, Z. Fardous, M. Nesha, M. H. Rashid and M. A. Rahman

Currently, soil contamination with pesticides is a concerning issue as soil is connected to environment as well as public health. Also, pesticides enter our food chain from contaminated soil and cause various types of health problems like cancer. Therefore, the aim of this study is to determine Soil Pesticides from pond & canal in Coastal Region of Bangladesh and their Ecological Impact on Environment.In this study, the concentrations of pesticides in the 25 soil samples were determined using High Performance Liquid Chromatography (HPLC) which were collected from different pond & canal in Coastal Region of Bangladesh.According to the result, some soil samples were contaminated with Carbamate(Carbofuranand Carbary) andOrganophosphorus (Diazinon) pesticide. The residue level of Carbofuran pesticides was ranged from0.303µg/kg to 1.851µg/kg and Carbaryl1.047 µg/kg.The highest concentration of carbofuran pesticide was found in SSP6 (1.851µg/kg) and the lowest was carbofuran found in SSP9 (0.303 µg/kg).Concentrations of Organophospho-rus (Diazinon) were found in soil sample: from 0.147µg/kg to 0.759 µg/kg (dry weight) which were higher than the EEC-recommended limit of 0.1µg/kg.Overall, the present study gives current understandings into the pesticides concentrations in soils and its contamination to food chain.

1.2 Assessment of heavy metals in sand and soil of Cox's Bazar Sea Beach, Bangladesh.

M. A. Z. Chowdhury, Z. Fardous, M. Nesha, M. A. Rahman and M. A. Uddin

Heavy metal concentration is a serious problem in sand and soil of some areas of Bangladesh. Human beings may be indirectly exposed to heavy metals in sand and soil through the respiration of sand and soil particles, dermic contact, and oral ingestion, which can seriously threaten health. This study assesses the health risks associated with heavy metals in sand and soil by determines the concentrations of four (04) heavy metals (Cd, Cr, Fe & Zn) using AAS. The twelve (12) surface sands samples and four (4) surface soil samples were collected from the Cox's Bazar Sea Beach. There was a considerable amount of heavy metals in sand and Soil

samples at the sampling area. The total maximum concentration of heavy metals in sand and soil Cd-0.0443 mg/L, Cr-0.7535 mg/L, Fe-65.8916 mg/L, Zn-1.1447 mg/L. The total minimum concentration of heavy metals in sand and soil Cd-0.0271 mg/L, Cr-0.0119 mg/L, Fe-24.4221 mg/L, Zn-0.0172 mg/L. The concentration levels of (Cr, Cd) were above in both sand and soil sample from maximum permissible levels from the standard guidelines of Department of Environment (DoE) and WHO limit ,EU limit for sand and soil. On the other hand (Fe, Zn) found higher concentration level than the standard guidelines of WHO limit and EU limit for sand and soil. Only Fe found much higher concentration and Cr found less above concentration both in sand and soil sample from the maximum permissible limits of the standard guidelines.

1.3 Detection and analysis of pesticide residues in ground and surface water at Ranisankail and Sarail Upazila of Bangladesh

M. Hasanuzzaman, M. A. Z. Chowdhury, Z. Fardous, M. H. Rashid and M. A. Uddin

With the increasing population followed by increasing demand of food, the use of pesticides has been increased a lot in the developing countries like Bangladesh. In this study, to detect and analyze a total of 7 organophosphorous, organochlorine and carbamate pesticide residues, 51 water samples of tube-well, pond and ditch were collected from Ranisankail Upazila of Thakurgaon District and Sarail Upazila of Brahmanbaria District and were analyzed by High Performance Liquid Chromatography (HPLC) fitted with Ultra Violate (UV) detector. Among the seven suspected pesticide residues, malathion was detected in 8 water samples in the concentration ranging from 20 to 565.48 μg/l. Diazinon was found in only one water sample at the concentration of 4326.49 μg/l. Except for the contaminated ditch water samples of Sarail Upazila, the other contaminated samples are above the Canadian and Australian guideline value. None of the water samples were found to be contaminated with chlorpyrifos, carbaryl, DDT and it derivatives. Necessary steps should be taken to reduce the pesticide application to lessen the possible health hazards. The aim of this study is to detect and measure the concentration level of some selected organochlorine, organophosphorus and carbamate pesticide residues in water samples collected from Ranisankail and Sarail Upazila of Bangladesh to detect the hazardous conditions so that, further appropriate steps can be taken to reduce the pesticide pollution.

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

Name of the participant	Title of the event	Organizer	Date	Place
Dr. M. A. Uddin, Dr. M. A. Z. Chowdhury	"National Seminar on Design & Construction License issuing Ceremony of Rooppur Nuclear Power Plant Unit 2". "National Seminar on Design & Construction License issuing Ceremony of Rooppur Nuclear Power Plant Unit 2".	BAERA	08 Jul. 2018	Hotel Pan Pacific Sonargaon, Dhaka

Food Technology Division, IFRB

Objective/Introduction

Food Technology Division is basically involved in carrying out research on improvement of food quality (nutritional, functional and microbiological quality) and storage condition through conventional and nuclear technology for food safety and security aspects. Research works of FTD also focus on development of convenience food and food additives from different kinds of food and food derivatives. Area-wise analysis of elemental and heavy metal in agricultural and dairy products through nuclear techniques is also in progress to develop a database for food traceability and authenticity.

Activities/Program

1. Research and Development Work(s)

1.1 Improvement of microbiological quality, antioxidant content and shelf life of jujube (*Ziziphus mauritiana* cv. BAU Kul) fruit by gamma irradiation

F. Mridha, R. Huque, Mst. A. Khatun, M. Islam, A. Hossain, A. Hossain and M. S. Kabir

Postharvest loss of inherently perishable fruits is a matter of serious concern for the farmers and traders. Reduction of postharvest loss is one of the key components for ensuring food security. A study was carried out to reduce the postharvest loss of BAU Kul, an improved variety of jujube fruit (*Ziziphus mauritiana*), by

using gamma irradiation. Different doses of gamma irradiation (0.5, 1.0 and 1.5 kGy) was applied to the jujube fruit samples and the microbiological quality, antioxidant content and shelf life of those fruits were evaluated. Gamma irradiation initially caused significant reduction of the total heterotrophic bacteria, coliform as well as yeast and mold counts. However, the counts increased in both irradiated and non-irradiated fruit samples with the passage of storage period but the increment was significantly less in the 1.5 kGy irradiated samples. Irradiation played active role in the enhancement of total phenolics and flavonoids contents. The concentration of these antioxidants remained higher in irradiated samples in comparison to non-irradiated control samples throughout the storage period. However, the ascorbic acid content decreased gradually with the increase of radiation dose and storage period. The overall acceptability of the fruit samples was determined by the taste-taking panelist. The irradiated (1.0 and 1.5 kGy) fruits were acceptable up to 8 days whereas control and 0.5 kGy irradiated fruits lost their acceptability during storage. The study revealed that 1.5 kGy irradiation can improve microbiological quality and extend the shelf life of jujube fruits (cv. BAU Kul) without significant loss of overall antioxidant content and sensory attributes.

1.2 Evaluation of elemental, microbial and biochemical status of raw and pasteurized cow's milk

R. Huque, Y. N. Jolly, T. R.Choudhury, M. K. Munshi, M. S. Hussain, A. Khatun, B. K. Roy, M. Islam, M. A. Hossain and A. Hossain

Description: Milk is a good source of nutrients for the children as well as for adult. In the present study, the concentration of lead, cadmium, chromium, copper, cobalt, nickel, arsenic, mercury, manganese, iron, zinc, calcium and magnesium were measured in both raw and pasteurized cow's milk by Atomic Absorption Spectroscopy (AAS). Results showed that pasteurized milk was more nutritious with signifcantly higher ($P<0.05$) concentration of Ca and Mg and was safer with signifcant lower concentration of Pb, Cd, and Ni compared to raw milk. In raw milk, Pb had the highest elemental concentration followed by others in the order Ni > Co > Cr > Cd > Cu. Values of As and Hg were below the AAS detection limit for both raw and pasteurized milk samples. The Daily Intake of Metal and Health Risk Index of the elements calculated from the obtained metal concentrations showed no potential to cause health risk to the consumer. Besides elemental analysis, chemical composition and microbial load in cow's milk were evaluated. The average Total Soluble Solids values of raw and pasteurized milk were 10.26 and 9.87% respectively. Acidity in both raw and pasteurized milk were in acceptable limit (<0.14). Microbiological load in pasteurized milk was less than standard limit (not exceeding 20,000 CFU/ml). Therefore, pasteurized milk from prescribed farm is good quality and safe for human consumption.

1.3 An Assessment of physical, nutritional and microbial quality of Shrimp (*Macrobrachium rosenbergii*) feeds of Bangladesh

M. Islam, M. A. Hossain, A. Khatun, M. A. Rahman, A. Hossain, M. S. Hussain, M. K. Munshi and R. Huque

One nursery feed and 11 growout feeds of shrimp (*Macrobrachium rosenbergii*) were analyzed to evaluate their physical, nutritional and microbial quality. Out of 12 feeds, one feed was powdered and 11 feeds were pelleted form. Among the entire pellet, sample C was shown the maximum length (ranges from 9.1 to 13.1 mm) and sample L (ranges from 0.1 to 7.0 mm) was found to have the minimum length. All of the feed samples were shown be have low protein content. Lipid and carbohydrate values were much higher than the recommended levels. However, the moisture content was in acceptable range. Calcium level was much higher and phosphorus was found lower in all the feed samples than the recommended level. Sample J showed the highest (7.86 mg/100 g) calcium values and the lowest (0.63 mg/100g) phosphorus values. Out of 12 feeds, 9 feeds were found to contain total bacterial count (TBC) within the permitted level.

1.4 Studies on the macro and micro nutrients of pulses in Bangladesh

M. A. Rahman, M. A. Hossain, M. Islam, A. Khatun, A. Hossain, M. S. Hussain, M. K. Munshi and R. Huque

The present study was carried out to evaluate the micro and macro nutrient of the common pulses of Bangladesh including Mosor (Lens culinaris), Mung (Vigna radiata), Boot (Cicer arietinum), Khesari (Lathyrus satuvus). The moisture contents of four pulses were found to be the same. Among the four pulses, Mosor contained the highest amount of protein (31.7%) whereas Khesari had the lowest content of protein (9.02%). On the hand, Boot had the highest amount of fat (3.2%) compared to Mosor, Mung and Khesari.

Meanwhile, the highest Iron content (7.09 mg/100g) was found in Khesari. The results of this study would provide important nutritional information about common pulses in Bangladesh which might be helpful to choose health beneficial pulse for daily meal.

1.5 Radiation sterilization effect on antioxidant, antimicrobial and FTIR spectral pattern of three types of monofloral honey of Bangladesh origin

A. Khatun, M. Razzak, M. Islam, A. Hossain, M. A. Hossain and R. Huque

This study was designed to find the simultaneous effects of irradiation application on honey antioxidant and antibacterial potential. Three types of unifloral honey such as mustard (*Brassica juncea*), Black seed (*Nigella sativa*) and Lychee (*Litchi chinensis)* were used for this experiment. Black seed honey has been found to possess highest antioxidant compound and showed significantly higher ($p=<0.01$) free radical scavenging activity. Radiation processing caused significantly increased phenolic compound as well as antioxidant activity in all honey types. Moreover, gamma radiation did not found to alter antibacterial potential. The molecular changes in honey composition due to irradiation were analyzed by FTIR (Fourier-transform infrared spectroscopy).

2. Manpower Development and Training Program

Title of the event	Date	Place	No. of participant
RAS5081: Regional Training Course on the Fundamentals of Using Nuclear Techniques for Verifying Food Authenticity	25 Jun. -06 Jul. 2018	Dunedin, New Zealand	1
TC project (BGD 5032): Sampling and analysis of stable isotope and trace element of food			5
MEXT Program: Molecular Biological Basis of variation in Radio Sensitivity Among Individual	25 Sept.2018-15 Feb 2019	Tokyo, Japan	1
TC project (BGD 5032): Basic molecular technique	11-20 Feb. 2019	Penang, Malaysia	4

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

Name of the participant	Title of the event	Organizer	Date	Place
Dr. R. Huque Dr. M. K. Munshi	TC BGD 5032 - Scientific visit	IAEA	25 Jun. - 06 Jul. 2018	Dunedine, New Zealand
Dr. R. Huque	CRP - 18195/R0 - Coordination meeting	IAEA	3-7 Sept. 2018	Ljubljana, Slovenia

4. Collaboration Work(s)

4.1 IAEA CRP Project

Code: 18195/RO

Title: Food traceability and food safety of dairy products as an example through the Nuclear analytical techniques

Description: Food authentication is the process that verifies that a food is in compliance with its label description which may include the origin. Milk is a high value-added product, rich source of natural nutrients for human being which contains more than twenty different trace elements. Milk is most susceptible to be mislabeled and their country of origin can sometimes be in question. In this regard, the use of multi elemental analysis could be a good tool for origin authentication purposes. The main objective of this project to differentiate the milk according to geographical region in Bangladesh based on elemental composition.

4.2 IAEA RCA Project

Code: RAS7026

Title: Supporting the use of receptor binding assay (RBA) to reduce the adverse impacts of Harmful Algal toxins on seafood safety

Description:. The research has focused on some principal aspects of harmful algae and their toxins such as to strengthen harmful algal bloom (HAB) monitoring capabilities in the coastal regions through the use of the Radioligand Receptor Binding Assay (RBA), a nuclear technique for Ciguatera and Puffer fish poisoning-reduce environmental and socio-economic costs of harmful algal blooms - toxin monitoring capacity: strengthen skills and competencies; extend to new type of marine toxins – environmental assessment: land-based pollution; nutrient over-enrichments.

4.3 IAEA RCA project

Code: RAS 5081

Title: Enhancing food safety and supporting regional authentication of food staff through implementation of nuclear techniques

Description: One of the primary tools for ensuring food safety is a traceability system. This provides the consumer with confidence that the product that they are purchasing comes from a supplier with the appropriate food safety and quality measures. All such systems are subject to failure either inadvertently or deliberately (fraud). The incidence of fraud is difficult to measure in Bangladesh. Thus, it is recognized that there is a need for an analytical system to independently verify the origin of food and hence augment the traceability control systems. Nuclear techniques have been shown to be very effective in authenticating food products (i.e. detection of adulteration or counterfeit), and in discriminating foods from different geographical origins. These systems have the potential to provide verification of information-based traceability systems and provide information on the integrity of the food product itself.

4.4 IAEA TC project

Code: BGD 5032

Title: Building capacity in improving food safety using nuclear and other complementary analytical techniques

Description: Fraud and fake incidents of food are frequently reported in the public media, which seriously affects the market development, and also have adverse impacts on the confidence of consumers for good brand and certified food. Driven by the high profits, the fraud and adulteration have not been rooted out and effectively stopped. However, conventional analytical methods are difficult to identify and determine the fake and adulterated products in most cases. The R & D of tracing techniques for discriminating the true or fake products lags behind the market requirements, and has become the bottleneck for effective market surveillance and management in the country. Hence, nuclear analytical strategy is required to verify the declared country of origin of food. The present study aimed at improving the food safety and quality control system by nuclear and other complementary analytical techniques to verify the food authenticity and traceability.

5. Service Rendered and Revenue Income

No. of service given to the organization	Nature of sample/service	No./quantity of sample	Income
INST Inter laboratory service	Vegetables	14	free of cost
NIB and 4 food manufacturing company	Poultry feed, Spirulina, Mushroom, Protein Powder	15	15,000
	Total	29	15,000/-

Gamma Source Division, IFRB

Objective/Introduction

Gamma Source Division (GSD) of IFRB has been rendering irradiation services since 1980 to different institutes/ organizations and private companies using Co^{60} panoramic gamma irradiator. GSD is the pioneer irradiation service provider in Bangladesh. Its main objective is to develop and utilize gamma irradiation techniques in research and commercial sectors for better quality products. GSD has provided irradiation services for research purpose to different government (including institutes of BAEC) and private

organizations at free of cost during this time period. During this time period, GSD has served irradiation to commercial products of 10 food industries and 31 medical & pharmaceutical companies of Bangladesh and earned 31,97,969/- revenue for the country. During this reporting period, the activities of the source were 55.06 kCi on 1st July, 2018 and 48.75 kCi on 30th June, 2019. At the same time, the dose rates were 2.35 kGy/hr on 1st July, 2018 and 2.02 kGy/hr on 30th June, 2019.

Activities/Program(s)

1. Research and Development Work(s)

GSD has provided irradiation services for research purpose to various Divisions/Institutes of BAEC, Bangladesh Sugarcane Research Institute (BSRI), ZAP Natural ltd., Nipa Pharmaceuticals, Rajshahi University, Jagannath University at free of cost during this time period. GSD provides irradiation service for research purpose to 345 food samples (Spirulina, fried rice, sugarcane seed, seeds of ladies finger, cheese, fish etc.) and 2056 medical samples (bone graft, bone chips, amnion graft, skull, hydrogel, massive bone, rubber stopper etc.)

2. Manpower Development and Training Program

Title of the event	Date	Place	No. of participant
Overview of Co-60 Gamma Source	13/11/2018	GSD office room	06
Irradiation process in GSD	20/11/2018	GSD office room	06
Utilization of Co-60 Gamma Source in GSD	27/11/2018	GSD office room	06
Food Irradiation and effects of radiation on food	04/12/2018	GSD office room	06
Irradiation of Pharmaceutical, medical & food products	11/12/2018	GSD office room	06
R&D activities of GSD	18/12/2018	GSD office room	06
Overview of Radiation Dosimetry in GSD	08/01/2019	GSD office room	06
Fricke Dosimetry in GSD and its utilizations	15/01/2019	GSD office room	06
Ceric-Cerous Dosimetry in GSD and its utilizations	22/01/2019	GSD office room	06
Proper use of Potentiometer for Ceric-Cerous dosimetry	05/02/2019	GSD office room	06
Record keeping in GSD	12/02/2019	GSD office room	06
Safety features of Co-60 gamma irradiator	19/02/2019	GSD office room	06
Proper use of TLD and survey meter, pocket dosimeter for personal protection	05/03/2019	GSD office room	06
Radiation monitoring program	12/03/2019	GSD office room	06
Area Radiation monitoring of GSD	19/03/2019	GSD office room	06
Emergency Response plan of GSD	09/04/2019	GSD office room	06
Possible radiation hazards in GSD	16/04/2019	GSD office room	06
Transportation of radioactive source	23/04/2019	GSD office room	06
Proper use of UV spectrophotometer for Fricke dosimetry	07/05/2019	GSD office room	06
Health Surveillance program of the radiation worker	14/05/2019	GSD office room	06
Quality assurance program in GSD	21/05/2019	GSD office room	06
Quality assurance of procedures	11/06/2019	GSD office room	06
Maintenance of Co-60 gamma irradiator	18/06/2019	GSD office room	06
Wipe test	25/06/2019	GSD office room	06

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

Name of the participant	Title of the event	Organizer	Date	Place
A. Nahar	Nuclear Cyber Security Awareness Program	Institute of Computer Science (ICS)	12-13th Nov., 2018	ICS

4. Stakeholder Meeting

Gamma Source Division (GSD) arranged a meeting for the first time with their regular stakeholders on 5th May, 2018 in the IFRB Seminar room. The title of the meeting was "An Overview of the Service Provided by Gamma Source Division". Stakeholders from different pharmaceutical & medical companies, food industries gave their opinions about their requirements from GSD. GSD also informed details to the stakeholders about their irradiation service and some new rules & regulation which were prepared for better irradiation service.

5. Service Rendered and Revenue Income

No. of service given to the organization	Nature of sample/service	No./quantity of sample	Income
10	Food irradiation	19.038 Ton	6,77,569/-
31	Medical and Pharmaceutical products irradiation	4699 cft 15800 pcs Shell Dressing	24,41,400/- 79,000/-
Total			31,97,969/-

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/Program(s)

1. Research and Development Work(s)

1.1 Efficiency of two larval diets for mass-rearing of the mosquito *Aedes aegypti*

M. Khan, N. Sultana, K. Seheli, M. A. Hossain, M. A. Bari, M. Momen and N. Khatun

Aedes aegypti is a major vector of arboviruses such as dengue (DENV), Chikungunya (CHIKV) and Zika (ZIKV) that may be controlled on an area-wide basis using the sterile insect technique (SIT). Larval diet is a major factor in mass-rearing for SIT programs. Accordingly, we compared dietary effects on immature development and adult fitness-related characteristics for laboratory based fish feed diet (Super Nova, Perfect Companion Group Co. Ltd., Thailand) and high quality feed for fingerlings, 'Micro-180' (Skretting, Neutreco company, USA) to use in SIT. The proportion of larvae that survived to pupation or to adult emergence did not differ significantly between diets under same rearing condition. Insects from the both diets treatment produced a good number of male pupae (~69% at second day of pupation), although total pupation is comparatively higher in 'Micro-180' diet. In other aspects the 'Micro-180' diet generally performed best. Larval development was faster on 'Micro-180' than Lab diet, 'Nova' fish feed. Adult males and females from the 'Micro-180' diet were significantly larger than those from the Lab diet. Females from the 'Micro-180' diet had significantly higher fecundity compared to the Lab diet. However, Adult flight ability and longevity did not differ significantly with larval diets, irrespective of sex. We conclude that 'Micro-180' diet is likely to be more suitable for mass-rearing of *Ae. aegypti* for area-wide SIT-based vector control.

1.2 A preliminary survey of host plant spp. of different *Bactrocera* and *Dacus* fruit flies in Atomic Energy Research Establishment (AERE) campus

M. Khan, N. Khatun, K. Seheli, M. A. Hossain, M. A. Bari, M. Momen and N. Sultana

Phytophagous *Bactrocera* and *Dacus* differ in their degree of specialization on availability and range of host plants. A complete record on the host plants range is needed for proper management of fly species. The

present study therefore conducted to estimate the possible host plants of different *Bactrocera* and *Dacus* fruit flies of Atomic Energy Research Establishment (AERE) campus, Ganak bari, Savar during 2018-2019. The AERE campus contains different local and exotic crop plantations (ornamental, fruits, medicinal), besides bushes and herbs. A short list of host plants was made during the study period. Total 177 plant species were identified in the study area among them 72 species were recorded as host plants for different *Bactrocera* and *Dacus* spp. The dominant perennial host plants spp. of AERE campus include mango, jackfruit, different types of nuts, papaya, etc. Whereas prominent annual host plants cultivated throughout the year includes sweet gourd, bottle gourd, wax gourd, bitter gourd, sponge gourd, white gourd, cucumber, melon, tomato etc. It was revealed that the host availability round the year supports the abundance of different species of *Bactrocera* and *Dacus* fruit flies in AERE campus.

1.3 Survey of dacine fruit flies in some protected forest areas of Bangladesh

M. A. Hossain, M. Momen, K. Seheli, S. A. Khan, M. A. Bari, N. Sultana, N. Khatun and M. Khan

Fruit flies (Diptera: Tephritidae: Dacinae) are the world most devastating insect pests of horticultural crops. Besides causing billions of dollars in direct losses to a wide variety of fruits, vegetables and flower crops they limit the development of agriculture in many countries because of the trade quarantines imposed to prevent their spread. All Dacinae fruit flies are frugivorous or florivorous and about 10% of the 932 currently recognized species are pests of commercial fruits and vegetables. For making any control measure to be effective and international commercial trade of fresh fruits and vegetables a checklist of fruit flies with their abundance and diversity is essential for crop protectionist. A preliminary fruit fly survey was conducted in Madhupur National Park, Bhawal National Park, Chimbuk Hill Forest and Hansama Hill Forest in Bangladesh (2018), using traps baited with the male lures methyl eugenol, cue-lure and zingerone, yielded 16 species of Dacinae fruit flies. Of these, four species, viz., *Bactrocera dorsalis* (61.12%), *B. ribigina* (18.14%), *Zeugodacus tau* (13.01%) and *Z. cucurbitae* (5.16%) are comparatively abundant in these protected forest areas. The total number of fruit fly species in Madhupur National Park, Bhawal National Park, Chimbuk Hill Forest and Hansama Hill Forest areas were 7, 9, 9 and 10 species respectively.

1.4 Efficacy of indigenous *Bacillus thuringiensis* strains against oriental fruit fly, *Bactrocera dorsalis* (Hendel) (Diptera: Tephritidae)

M. A. Bari, S. A. Khan, K. Seheli, M. A. Hossain, M. Momen, N. Sultana, N. Khatun and M. Khan

A total of nineteen indigenous *Bt* strains were tested against 3rd instar larvae of oriental fruit fly, *Bactrocera dorsalis*. Out of the nineteen indigenous *Bt* strains tested, nine strains were found to exhibit significant toxicity against the 3rd instar larvae as *Bt* MuSc4 (53%), Dse1 (57%), Dsf4 (65%), KSa2 (66%), MuSc2 (68%), JDc1 (73%), NaSc3 (75%), FhSb3 (78%) and JSd1 (90%). The highest mortality was counted for *Bt* JSd1 (90%) as well as lowest for MuSc4 (53%). Based on the LC_{50} (Logarithmic value of spore count) as estimated by Probit analysis. The lowest LC_{50} values observed varied for *Bt* JSd1 (0.48) gm/ml followed by JDc1 (0.64), FhSb3 (0.68), NaSc3 (0.72), MuSc2 (0.78), DSf4 (0.79), KSa2 (0.79), DSe1 (0.94) and MuSc4 (1.05) gm/ml. The dose and time response based bioassay of this study thus enabled us to identify the effective *Bt* strains such as *Bt* JSd1 in controlling *B. dorsalis* 3rd instar larvae with lowest dose and shortest time in the laboratory which upon field trial will be promising for large-scale production of efficient *Bt* biopesticide and sustainable delivery to the farmers to ensure and encourage the establishment of an environment-friendly biopesticide.

1.5 Ovitrap surveillance of the dengue vectors, *Aedes aegypti* (L.) and *Aedes albopictus* (Skuse) in AERE campus

M. Momen, K. Seheli, S. A. Khan, N. Sultana, M. A. Hossain, M. A. Bari, N. Khatun and M. Khan

One of the options for IVM program implementation is placing ovitaps. In these novel traps motherly instincts of mosquitoes is used against them to fight the spread of disease by the container breeding mosquitoes. Trapping devices is provided with just the right mix of water and attracting substances (0.50gm/3 liter water) convince the disease-carrying mosquitoes they've found the perfect place to lay their eggs. Number of mosquito caught weekly per trap can provide the population fluctuation thought the year of different species of container breeding mosquitoes. In our experiment we deployed ovitraps at four sites across the AERE campus including office area, housing area and vegetation. These traps were monitored once per week to record mosquito population, species diversity and preference to ovitraps. Our team monitored the surveillance traps weekly from January, 2019 and further survey will going on up to February 2020. This

preliminary study reveals that *Aedes albopictus* (Skuse) is the dominant (more than 95%) dengue vector followed by *Aedes aegypti* (L.) (less than 5%) in AERE campus. Analysis of the present data showed that mosquito population is very low during the winter season. However, a detail study is required for final conclusion.

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

Name of the participant	Title of the event	Organizer	Date	Place
N. Khatun	Basic Nuclear Orientation Course-2018 (2nd Batch)	BAEC	09 Sept. -01 Nov. 2018	TI, AERE
Dr. M. Khan and N. Sultana	National Biotechnology Fair - 2018	NIB	7-8 Sep. 2018	BSMR Novo Theatre BAEC
Dr. M. Khan, Dr. K. Seheli, M. Momen and N. Sultana	Challenging Research by Women in STEM	OWSD-BD (Bangladesh National Chapter)	10 Nov. 2018	BAEC
M. A. Bari	Nuclear Cyber Security Awareness	BAEC	12-13 Nov. 2018	ICS, AERE
Dr. M. Khan, Dr. M. Aftab Hossain, Md. A. Bari, M. Momen and N. Sultana	Conservation of Animal Habitats for Sustainable Biodiversity	Zoological Society of Bangladesh	7-8 Dec. 2018	Shishu Academy & DU
N. Sultana	(FTC) 'Environmental Radioactivity Monitoring Course	BAEC	13-17 Jan. 2019	TI, AERE
M. A. Bari	Sector Leaders Workshop 2019	Ministry of Science & Technology	8-9 Feb. 2019	DRiCM Hall, BCSIR
N. Sultana	Oceanography: Principles and Application	NOAMI	23 Feb.- 30 Jun. 2019	NOAMI, Dhaka
M. A. Bari	Trends in Microbiology for Sustainable Agro ecological Development	Society of Microbiologists	6 Aprl. 2019	Dept. of Microbiology, JUST

3. Collaboration Work

3.1 IAEA RCA Project No. RAS/5082 (2017-2021) titled 'Managing and Controlling *Aedes* Vector Populations Using the Sterile Insect Technique'

3.2 IAEA INT5155 (2015-2019) titled 'Sharing Knowledge on the Sterile Insect and Related Techniques for the Integrated Area-wide Management of Insect Pests and Human Disease Vector'

3.3 FAO/IAEA Coordinated Research Programme CRP No.-23135 (2019-2024) titled 'Assessment of Simultaneous Application of SIT and MAT to Enhance Bactrocera Fruit Fly Management'

3.4 MOST, GOB, R&D project (July, 2018-June, 2019) titled 'Molecular Identification of Severe Fruit Fly Pest (Diptera: Tephritidae) through the DNA Barcoding of COI gene'

3.5 Collaborative research work between IBD, IFRB and Idaho University & Hawaii University at Manoa, USA on 'Species diversity of tephritid fruit flies in Bangladesh'

4. Others

- Dr. Mahfuza Khan worked as Co-chair of a 'Technical Session' of International Seminar cum Workshop entitled 'Challenging Research by Women in STEM' and to Celebrate '25th Anniversary of

OWSD (Organization for Women in Science for the Developing World)'- by OWSD-BD (Bangladesh National Chapter)', 10th November, 2018 at Dr. M. Anowar Hossain Auditorium, BAEC HQ.

- Worked as Reviewer of National/International/on-line Journals.

Microbiology and Industrial Irradiation Division, IFRB

Objective/Introduction

This division is one of the pioneer divisions of IFRB. The division deals with microorganisms those are closely associated with the health and welfare of human being. MIID is basically involved in doing research and development work on different aspects of Radiation Microbiology. The R & D activities conducted for the reporting period are given below:

Activities/Program(s)

1. Research and Development Work(s)

1.1 Development of "Synergy Biofertilizer" in combination with chitosan for rice plants

M. K. Pramanik and S. Sultana

To study combined effect of chitosan as PGP and *Azospirillum* species as biofertilizer on rice plant a semi-field level experiment was carried out at AERE campus. Six treatments were applied with triplicates viz, T_1: 100% chemical fertilizer, T_2: 50% chemical fertilizer, T_3: 50% chemical fertilizer +100ppm chitosan, **T_4:** 50% chemical fertilizer +100ppm chitosan+ biofertilizer, T_5: 50% chemical fertilizer + biofertilizer and T_6: Control (native nutrient). Rice variety, BRRI-129 was selected as test rice variety and several parameters including tiller height and number, panicle length and grain yield were assessed to determine if any synergy effect of chitosan and biofertilizer is present. Result showed that the highest tiller no (17.4/hill) and height (89.72 cm) was found in T_2 and T_3–treatment respectively and no synergy was found with respect to these parameters. The highest panicle length (25.08 cm) and grain no./panicle (167.2) were found in T1 and T5-treatment and were almost unaffected with either treatment. No synergistic effect of PGP and biofertilizer was found in straw weight. Grain yield of rice (t/ha) was increased up to 1.77% in T_4–treatment. Grain size was increased upto 5.25% in the T_4-treatment as measured by 1000-grain weight which can be considered as synergistic effect of PGP and biofertilizer because the combined effect of PGP and biofertilizer is greater than the sum of individual effect of PGP (0.45 %increase) and biofertilizer (0.21% increase). Overall results indicate that integrated use of chitosan (100ppm) plus biofertilizer along with (50%) chemical fertilizer has some synergistic effect only with respect to grain size.

1.2 Partial characterization of bacteriocin produced by locally isolated lactic acid bacteria

A. A. Mahin, B. Bhowmik and F. Hossen

In this study, a comprehensive screening was undertaken to isolate Lactic Acid bacteria (LAB) capable of producing bacteriocin from broiler chicken intestines. Antagonistic activity of the bacteriocin producing LAB isolates against indicator strains such as *Escherichia coli*, *Salmonella enteritidis*, *Micrococcus luteus*, *Listeria monocytogenes*, and *Bacillus coagulans* was assessed using a standardized agar well diffusion method. The activity was determined under conditions to exclude the possibility of growth inhibition due to production of organic acids or hydrogen per oxide by the isolates. The method for extraction of crude bacteriocin from culture supernatant and further concentration of the bacteriocin was standardized. The crude concentrated bacteriocin was found to successfully inhibit the growth of above mentioned indicator bacteria. The most potential bacteriocin producing LAB, CHI-12, was identified as *Lactobacillus salivarius* based on 16s rDNA sequencing.

1.3 Response surface modeling for enhanced bioethanol production from rice straw through consolidated bioprocessing

A. A. Mahin, F. Z. Nishat and M. S. Rahman

In our previous study, we isolated 4 potential cellulolytic (S3, S5, W5 and W13) microorganisms capable of producing high endoglucanase, β-glucosidase and xylanase activities. We now identified the microrganisms as *Streptomyces filamentosus*, *Bacillus subtilis* (2 isolates), and *Bacillus aryabhattai*) based on 16S rDNA sequencing. *Bacillus aryabhattai* showed highest ethanol production (4.7 g/L) from the medium containing 20 g/L Rice straw (RS). In order to obtain maximum ethanol production, fermentation media were statistically designed. The effect of various medium ingredients was evaluated initially by Plackett-Burman Design (PBD)

where Na_2HPO_4, peptone, inoculum concentrations and fermentation time showed significantly positive effect (*p*-value < 0.05) for ethanol production. Final optimization was done using Response Surface Modeling (RSM). *Bacillus aryabhattai* produced 11.06 g/L ethanol using 20 g/L RS, 0.25% Na_2HPO_4, 2% peptone after 60 h fermentation with 7.5% inoculum. The study concluded with the finding that *B. aryabhattai* is a potential candidate for industrial-scale bioethanol production from RS via CBP.

1.4 Screening and molecular identification of Poly-β-hydroxybutyrate (PHB) producing bacteria isolated from gamma irradiated textile wastewater

T. Mumtaz, S. M. E. Kaiser and M. A. K. Azad

The present study deals with the characterization of biopolymer (PHB) producing bacteria from the textile wastewater. The bacteria were screened by morphological and biochemical characteristics. Eight strains initially isolated from Gamma irradiated textile wastewater were characterized morphologically.Cells of T1 and T2,T5,T11 and T12 were rod shaped and other three strains T3, T4, and T19 are Coccus. All strains are gram positive. Three isolates were α haemolysis, three isolates exhibited β haemolysis and one isolate was γ haemolytic. The bacteria were further identified by Nile red and molecular characterization.5 out of 8 isolates exhibited PHB production ability after screening by plate assay.Yellow color granules of bacteria T12 were fluorescence by Acridine orange straining. Maximum number of PHB producers was found in T12 and it contained the isolates with maximum PHB accumulation. Number of PHB producer and accumulation in different sample were in the order T12> T11> T4> T3 > T5. The highest PHB content with different carbon sources during the study was in the order of glucose > sucrose> xylose> maltose> fructose. These isolated bacteria were identified by 16S rRNA sequencing and using BLAST. The following bacteria Kytococcussp (T3), Brachebacteriumsp (T4), Fictibacillusbarbaricus (T5), Brevibacteriumsp (T11), Brevibacteriumcasei (T12) were found. Neighbor joining method was used to produce a phylogenetic tree. These bacteria can be used to produce polyhydroxybutyrate (PHB) which is an organic polymer with commercial potential as a biodegradable thermoplastic..

1.5 Determination microbiological status of sediment of Dhaleswari river and isolation of Cr (VI) tolerant bacteria from it

M. R. Khan, A. B. Miah, M. A. K. Sarker, R. Khan and M. K. Pramanik

Abstract

Environmental pollution has been emerged as a prime global concern. One of the biggest causes of this pollution is the discharge of untreated effluent from industries into environment. This study focused on determination of microbial load on river bed and isolation of Cr (VI) tolerant bacteria from sediments. Microbiological status of river bed was checked by using standard plate method and potential Cr (VI) tolerant bacteria was determined by 1,5- diphenylcarbazide (DPC) method. Microbial count was found to vary between 1.4×10^3 and 9.64×10^5 cfu/gm for total bacterial count (TBC) and for total coliform count (TCC) between 6.0×10^2 and 1.01×10^4. In both cases, microbial load found not to vary with the distance between effluent discharge point and sampling points. Another feature found in test results that (46.64-99.04) % of TBC is TCC. In Cr (VI) tolerant bacteria screening study, 4 isolates RKD1, RKD2, RKD4 and RKD11 were found those are able to tolerate 100 mg/L of $K_2Cr_2O_7$ in the cultivation media among 11 distinct type isolated colonies. Therefore, further study on these potential isolates need to conduct as these could be promising one in exploitation of microorganisms to detoxify polluted, poisonous effluent containing high level of metal.

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

Name of the participant	Title of the event	Organizer	Date	Place
Dr. M. K. Pramanik	FNCA-workshop, (Biofertilizer project)	National Nuclear Center of the Republic of Kazakhstan	08-12 Oct. 2018	Kurchatov, Kazakhstan
Dr. T. Mumtaz	Attended as Panelist and poster presenter inUTKARSH 2018: Empowering and Enabling Women in Science	CSIR-NEERI, India and OWSD	30-31 Oct. 2018	New Delhi, India

Name of the participant	Title of the event	Organizer	Date	Place
	Attended Annual Meetings and Conference for American Association of Advancement of Science as participant and award recipient.	AAAS	14-17 Mar.2019	Wasington DC, USA
Dr. A. A. Mahin	Implementation of laboratory quality assurance (QA) and quality control (QC) system for analytical laboratory	ADP Project Modernization of Food and Radiation Biology Facilities of Bangladesh Atomic Energy Commisionl'	11-25 Jun. 2019	Global Centre for environmental Remedation, the University of Newcastle, Australia
	BAS-Young Scientist Congress	Bangladesh Society of Microbiologists & Department of Microbiology, DU	14-15 Sept. 2018	Bangladesh Academy of science, Agargaon
	32nd Bangladesh Society of Microbiologists BSM) Annual Conference 2019	Bangladesh Society of Microbiology	6 Apr. 2019	JSTU,Jessore
	National Biotechnology Fair-2018**,**	Jointly organized by National Institute of Biotechnology (NIB) & Science and Technology Ministry of Government of Bangladesh	7-8 Sept. 2018	BSMR Novo Theatre, Dhaka

3. Lecture delivered

Title of the event	Date	Place	No of participant
BNOC Training Course on "Exploitation of microbes for beneficial application using nuclear technology"	May, 2018	TI, AERE	30

4. Collaboration Work(s)

- S&T Project on "Production of microbial polyesters –polyhydroxyalkanoates (PHAs) by bacteria isolated from compost" FY 2017-2018 Investigator
- CRP projects entitled 'Disinfection of archieved materials by radiation' and FNCA project on 'Biofertilizer' under the auspices of International Atomic Energy Agency (IAEA)
- Active collaboration with Dhaka University, Jahangirnagar University, Jessore University of Science and Technology, Kushtia Islamic University etc. for academic and research purposes

5. Service Rendered and Revenue Income

No. of service given to organization	Nature of sample/service	No. of sample/ quantity	Income
6	Food/Feed (Microbiological analysis)	16	93000/-
9	Pharmaceutical (Microbiological analysis)	9	47200/-
Total			140200/-

Radiation Entomology and Acarology Division, IFRB

Objective

The R&D activities of Radiation Entomology and Acarology Division focuses on development of environmentally safe integrated pest management techniques against agricultural insect pests of economic importance by using gamma radiation, sterile insect technique (SIT), insect pest management by genetic manipulation, biodegradable botanicals, hormones, pheromones, bio- control agents and insecticides.

Activities

1. Research and Development Work(s)

1.1 Consequences of male and female fly ratios on reproductive potentiality and adult longevity in Blow Fly, *Lucilia cuprina* (Diptera: Calliphoridae)

With a view to produce a good number of potential blow flies for SIT program, a good proportion of male and female flies need to be combined in laboratory condition. From this aspect, a number of ratios of female flies have been combined per male to observe the reproductive potentiality and longevity for each ratio. The highest (3.0 ± 0.447) number of egg mass was revealed from 1:5 ratios of male and female flies. But there was no significant ($P > 0.01$) difference in egg mass number from 1:1 to 1:5 ratio. Whereas the weight of the total egg mass was significantly ($P < 0.01$) varied among the ratios. Female flies showed a more or less similar linear position (34 to 36 days) at different ratio for longevity. Male flies ended up with a short lived (16 days) phenomena at 1:1 ratio while a sharp peak (32 days) was marked for male longevity at 1:4 ratio. From this experiment it can be concluded that there must be an arrangement for at least four female per male in order to have a mass production and a good number of potential progeny.

1.2 Effect of temperature on life cycle of lime butterfly, *Papilio demoleus* L. (Lepidoptera: Papilionidae)

Papilio demoleus is considered among the major insect pest of citrus plantations. The development periods; incubation, larvae, pre-pupal, pupal and total life cycle (egg to adult emergence) affected by different temperature ranges. The incubation, larval pre-pupal, pupal and total life cycle mean time observations was 3.063±0.171, 14.84±2.21, 1.062±0.171, 10.09±0.841 & 29.33±2.75 days respectively at temperature ranges 27.67^0 to 30.53^0 C and 4.812±0.403, 21±3.66, 2.062±0.442, 68.25±10.39 & 96.12±35.21d days respectively at temperature ranges 18.55^0 C to 25.37^0C. We also found that highest number (65.38%) green pupae was due to pupal development in high temperature in contrast highest number (76.19%) brown pupae was due to pupal development in low temperature. All development periods; incubation to total life cycle have statistical significant difference at different temperatures ranges ($P<0.05$). In our country there have no mentionable works on biology of *P. demoleus* followed by temperature throughout the year. So the present study objective might help to proper management of this pest at the appropriate stage.

1.3 Biology of the common mormon butterfly, *Papilio polytes* L. (Lepidoptera: Papilionidae) on citrus leaves

Biology of *Papilio polytes* was studied on Citrus leaves under laboratory condition at temperature of 29.57°C ±1.59°C with relative humidity 72.5% ±4.95%. The incubation period was 3.54±0.45 days followed by five larval instars covering a total period by 15.5±0.89 days (3.17 ± 0.59 days for first, 2.47±0.61 days for second, 2.47±0.49 days for third, 2.77±0.73 days for fourth and 4.62±1.16 days for fifth instar). Pre pupal and pupal period lasted 1.03±0.12 days and 10.58±0.47 days respectively. The development of *P. polytes* from egg to adult emergence took on an average of 30.65±2.91 days. The entire life cycle (Egg to until death of adult) completed on an average of 39.29±3.16 days and 42.57±3.83 days and have no statistical significant difference on life cycle durations ($P>0.05$) of male and female respectively. Mortality rate for larval stages (1st to 5th instar) were 7.61%, 4.71%, 7.41%, 9.33% and 4.17% and mortality at pupal stage was recorded as 7.69%. The female butterfly lived longer (11.92±8.24 days) than male (8.64±7.33 days) and longevity of male and female were not statistically significant ($P>0.05$). The morphometric variations of different life stages of the *P. polytes* butterfly were recorded. The present study was undertaken to know the biology of *P. polytes* which would be useful to control and conserve this species in this country.

1.4 Effect of nutritional constraint on fecundity in *Bactrocera cucurbitae* (Diptera: Tephritidae)

The effect of nutritional constraint on the fecundity of *Bactrocera cucurbitae* (Diptera: Tephritidae) was investigated using constant feeding diets with different yeast and sugar ratios. We recorded the fecundities of

continuously mated females fed diets containing four yeast-to-sugar ratios such as 0: 100; 1.96: 98.04; 4.76: 95.24; and 25: 75. Study showed the increase of mean fecundity as well as the highest fecundity with the increase of yeast to sugar ratio i.e., highest for the ratio of 25% and lowest for 0%. Study also suggested that the decrease of sugar considerably modulate fecundity of the fruit fly.

1.5 Lifecycle Study of the Melon fly, *Bactrocera cucurbitae* (Coquillett) (Diptera: Tephritidae) on artificial adult diets

Yeast and sugar (1:3) as Diet 1 and Yeast, Sugar and Casein hydrolysate (1:3:1) as Diet 2 were served as adult diets in the laboratory of Institute of Food and Radiation Biology (IFRB), Savar, Dhaka to study the life time duration of the melon fly, *Bactrocera cucurbitae* for two consecutive generations (F1 and F2). Egg incubation period was similar in both diet and generation (Mean = 2.33 days). Larval and pupal period were slight higher in one replication of Diet 2, indicating that Diet 1 could be the favorable food for mass scale rearing the melon fly in Sterile Insect Technique (SIT) program. Adult emergence percentage was also presented the same result (Mean % = 87.33, Mean % difference = 1.80).

1.6 Impact of optimal diet and sucrose on longevity of males of *Bactrocera cucurbitae* and *Bactrocera tau* (Diptera: Tephritidae)

Impact of optimal diet (OPD) and sucrose on survivorship of adult males of *Bactrocera cucurbitae and Bactrocera tau* has been studied in the present study. Flies fed optimal diet (Sucrose and Protein in 3:1 ratio) from the day of eclosion demonstrated survivorship of 88.0 % and 80.8% respectively in *B cucurbitae and B tau* in 30 days. At the same time, flies fed only sugar resulted survivorship of 87.2% and 70.3% respectively in *B cucurbitae and B tau* during the study period. In this experiment, flies fed on OPD showed more survivorship than those fed only sugar. Study showed OPD to be ideal food for both flies.

1.7 Morphological characteristics of mitotic metaphase karyotypes of the Peach fruit fly, *Bactrocera zonata* (Saunders) and the Pumpkin fruit fly, *Zeugodacus tau* (Walker) (Diptera: Tephritidae)

Tephritid fruit flies are one of the most devastating agricultural insect pests in temperate, subtropical and tropical countries. Near about 800 species of fruit flies are documented from Oriental region. Species under the genus *Bactrocera* are liable for the loss of fruit and vegetable production in agro-based countries. Considering the economic importance of these flies, various control measures have been adopted in different countries. Among them, the Sterile Insect Technique (SIT) has been intended for its environmental friendly autocidal tactics. Under the umbrella of IPM, genetic control method would be the best alternative of fruit fly control where genetic and cytogenetic knowledge played an integral role for the construction of genetic tools in biological control program. The mitotic metaphase karyotypes of the peach fruit fly, *Bactrocera zonata* and the pumpkin fruit fly, *Zeugodacus* (*Bactrocera*) *tau* were studied. The mitotic metaphase complements of both species comprise of six pairs of chromosomes, including one pair of heteromorphic sex chromosomes. In *B. zonata* chromosome 2, 5 and 6 are submetacentric and 3, 4 are metacentric. In case of *Z. tau* chromosome 2, 3, 4 and 6 are metacentric and only chromosome 5 is submetacentric. X chromosome in both species is metacentric and heterozygous Y chromosome is dot like. The mitotic metaphase karyotypes of these two species present here are suitable for cytogenetic studies. It also facilitates knowledge for the development of genetic tools in SIT.

2. Seminar/Symposium/Conference/Workshop Attended

Name of the participant	Title of the event	Organizer	Date	Place
Dr. F. Yesmin	First International Conference of Biological Control Approaches and Applications ICBC2018)	Society for Biocontrol Advancement, India	22-29 Sept. 2018	Bengaluru, India
	International Seminar cum Workshop by OWSD-BD	Organization for Women in Science for the Developing World (OWSD)- Bangladesh Chapter	10 Nov. 2018	Agargaon, BAEC HQ, Dhaka

3. Collaboration Work(s)

Title of the project: Cytogenetic analysis of peach fruit fly, *Bactrocera zonata* (Saunders) (Diptera: Tephritidae) in Bangladesh with relation to sterile insect technique (SIT) application

Funding authority: The World Academy of Science (TWAS)

Period: December 2016- December 2018

Veterinary Drug Residue Analysis Division, IFRB

Introduction

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 in foods of animal origin. Specifically, the aim of this division is to monitor and control the residues of veterinary drugs in foods of animal origin to protect the public health and to promote international trade of Bangladeshi foods.

Activities/ Programs

1. Research and Development Work(s)

1.1 Development and validation of screening/analytical methods for detecting veterinary drug residues in foods of animal origin.

1.2 Monitoring and control of veterinary drug residues in foods of animal origin to protect public health and to promote international trade through utilization of nuclear and allied analytical techniques.

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

Name of the participant	Title of the event	Organizer	Date	Place
Dr. M. N. Islam M. M. Nabi	TC meeting on general requirement for competence of food safety testing laboratories	International Atomic Energy Agency (IAEA)	24-28 Sept. 2018	Indonesia
Dr. M. J. Islam Dr. M. N. Islam	Regional training course on development and analytical method for veterinary drugs and pesticide residues in animal products	International Atomic Energy Agency (IAEA)	12-23 Nov. 2018	Philippines
Dr. M. N. Islam M. H. Islam	Determination of Mycotoxins in foods and feeds of animal Screening of veterinary drug residue in foods of animal origin	Govt.of Bangladesh (ADP)	01-30 Apr. 2019	Belgium
M. M. B. Prince D. chakma	Training course on application of Statistical principles to food safety laboratories and national monitoring plans/programmes including sampling.	International Atomic Energy Agency (IAEA)	16- 20 Jun. 2019	Jordan

3. Collaboration Work/MoU

S & T Project Code: 2018-2019

Title: Determination of Beta-lactam antibiotic residue in cow's milk using nuclear technique.

Principal investigator: Dr. M. Jahurul Islam and Associate investigator: Dr. A S M Saifullah

4. Service Rendard and Revenue Income

Name of service provided	No./quantity of sample	Revenue income
Patient Service		
Sample Analysis	5	5,000/-
NDT Service		
Irradiation of Food/Medical Product		
Total		5,000/-

Plant Biotechnology and Genetic Engineering Division, IFRB

Introduction

Plant Biotechnology and Genetic Engineering Division is a leading research oriented laboratory in the country. It initiated research on plant tissue culture in the early eighties with micropropagation of forest trees. Later on the other crop plants like cereals, fruit, medicinal, ornamental, vegetable, spices etc. have been included in the program. In the mid-nineties research on *Agrobacterium*-mediated genetic transformation has been initiated with the fiber crop jute and this technique is expanded gradually to other plants of economic importance viz. rice, tomato and Papaya. Now the scientists of this division are doing their research on mutation breeding to improve crop plants besides the previous program.

Objectives

- To develop suitable protocol for disease free and high yielding plantlets production through *in* vitro culture
- To establish in vitro protocol for commercial production of forest, fruit, medicinal and ornamental plants
- To identify the desired tissue culture derived lines from seed, embryo and anther culture through observational trials and primary yield trials
- To develop Agrobacterium- mediated genetic transformation technique to improve crop
- plants
- To improve crop plants through mutation breeding using Carbon Ion beam and Gamma irradiations
- To molecular characterization of mutant lines

Activities/Program

1. Research and Development Work(s)

1.1 Measurement of the amount of nitrogen fixed by a legume crop using tracer technique

M. H. Kabir, A. N. K. Mamun, M. M. Islam, M. M. Islam and P. Das

Lentil is an important pulse crop in Bangladesh and grown throughout the country in Rabi season. The cultivated area is about 1,54,515 hectares of land and total production is about 1,58,228 mt with an average yield of <1.0 t/ha. Legumes in the crop rotation is attributed to the amount of N residue for the subsequent crop resulting from Biological Nitrogen Fixation. It can fix atmospheric N via symbiotic rhizobia root nodules and consequently has potential in rotation for maintaining soil fertility. Being a legume, lentil can fix its own nitrogen from the atmosphere and helps in restoring of soil fertility if effectively nodulated. Nodulated roots of lentil and residue left after harvesting are valuable sources of N for subsequent crops. There is clear evidence that legumes contribute to subsequent cereal crops and organic nitrogen in the soil. Keeping this in view, a study was conducted to assess the amounts of atmospheric nitrogen fixed by lentil using isotopic technique as influenced by treatments (N-fertilizer).

In this experiment, in case of lentil, 3 treatments (T_0= 0 kg N/ha, T_1=11.5 kg N/ha and T_2 =25.3 kg N/ha) were used. 15N was applied only in the micro plots with the treatment T_2. Experiment was done at BINA substation, Ishurdi, Pabna. Experimental design was RCBD, plot Size: 4m x 3m = 12m^2, spacing: 30cm (row to row, Lentil), 15cm x 20cm (Wheat, reference crop), 15N micro-plot size: 1.0m x 1.0m, replication: 4. For lentil, T0 = 0 kg N/ha + 160 kg TSP/ha + 110 kg MOP/ha, T1 =11.5 kg N/ha + 160 kg TSP/ha + 110 kg MOP/ha and T2 =25.3 kg N/ha + 160 kg TSP/ha + 110 kg MOP/ha. 15Nwasapplied only in the microplots with the treatment T2. Amount of non-labelled urea required (lentil): T1 @ 11.5 kg N/ha i.e., amount of urea required: (100 * 11.5)/46= 25 kg/ha=2.5 g/m^2. Therefore, for 4 plots 12x4=48m^2=48x2.5=120g. For T2, @ 25.3 kg N/ha i.e., amount of urea required: (100 * 25.3)/46=55 kg/ha=5.5 g/m^2 and for 4 plots 11x4=44m^2= 44x5.5= 242g. Total non-labelled urea required: 120+242=362 g. Amount of 15N labelled urea required (Lentil): 15N labelled urea with 5% atom excess i.e., @ 25.3 kg N/ha and for 1.0 m * 1.0 m micro plot=5.5 g/m^2. Total ^{15}N for 4 micro-plots=5.5x4=22g. For wheat, amount of non-labelled urea required @ 80 kg N/ha=(100 * 80)/46=173.91 kg/ha=17.39 g/m^2.For 4 plots (11x4=44m^2)=17.39x44=765.16g. Amount of 15N labelled urea required for micro-plot (1.0 m * 1.0 m) @ 80 kg N/ha = 17.39 g/m^2. Total ^{15}N for 4 micro-plots=17.39x4=69.56g. Total non-labelled urea required: 362.00g (lentil)+765.16g (wheat)=1,127.16g. Total 15N labelled urea required: 22.0g (lentil) + 69.56g (wheat) =91.56g.

Results obtained (Table 1) showed that T_1 (11.5 kg N/ha) performed the best and gave the highest nodule number/plant (65.95), seed yield (1.52 t/ha), 1000 seed weight (35.08g), filling pod/plant (112.03), primary branches (2.72), plant height (43.08 cm) and harvest index (33.73%) against 11.5 kg/ha N level followed by control and 25.3 kg/ha N levels respectively. Nitrogen rates significantly affected the lentil growth, yield and related traits. T1 performed the best and gave the highest nodule number/plant (65.95), seed yield (1.52 t/ha), 1000 seed weight (35.08g), filling pod/plant (112.03), primary branches (2.72), plant height (43.08 cm) and harvest index (33.73%) against 11.5 kg/ha N level followed by control and 25.3 kg/ha N levels respectively. This might be due to the fact that nitrogen contributed maximum growth and yield of lentil at optimum dose of 11.5 kg/ha N level. 15N data of plant samples were estimated using IRMS in cooperation with PNRI, Philippine. Upon calculation, it was found that lentil obtained 85% of its nitrogen from atmospheric fixation, up-to 8% from soil and 7% from the fertilizer. Most of the fixed N was utilized for its yield and biomass production.

1.2 Genetic improvement of sugarcane (*Saccharum officinarum*) var. China using gamma irradiation and large scale plantlet production through *in vitro* culture

M. M. Islam, P. Das. M. M. Islam, M. T. Jahan, M. R. Islam, M. H. Kabir and A. N. K. Mamun

Sugarcane (*Saccharum officinarum*) is one of the most important cash crops in Bangladesh and used to produce some essential foods in the form of sugar, gur and juice. It belongs to the family Gramineae and also to export product of many developing countries. Very little information is available about the application of mutation breeding through gamma irradiation to improve the agronomic traits of sugarcane. Therefore, this study attempted to improve the sugarcane (*Saccharum officinarum*) var. China using gamma irradiation and large scale plantlet production through *in vitro* culture system, which will be helpful for further study of sugarcane improvement to meet the challenges of sugar production in the country. The use of gamma radiation to induce mutation is a method that has been applied in plant breeding to increase genetic variation. The use of gamma radiation to induce mutation is a method that has been applied in plant breeding to increase genetic variation. It has also been used as an effective method, which can greatly induce high mutation numbers and modify physiological characteristics to create new mutants with improved properties. True genetic changes are desirable in mutation studies. Many fruitful agronomical changes (high cane yield, high sugar content) reported through mutation breeding in sugarcane. It has also been used as an effective method, which can greatly induce high mutation numbers and modify physiological characteristics to create new mutants with improved properties. True genetic changes are desirable in mutation studies.

This research sought to study *in vitro* plant regeneration of sugarcane (*Saccharum officinarum*) calli and to determine LD50 of gamma ray for irradiation of embryogenic calli. This research was conducted Plant Biotechnology Laboratory, Institute of Food and Radiation Biology, savar, Dhaka. Leafrolls of sugarcane were cultured on callus-inducing medium containing MS+10.0 mg/l NAA and axillary buds were cultured on MS+1.0 mg/l BAP+ 0.5 mg/l NAA owning to direct shoot induction. Culture after 60 days, about 90% and 80% of the leaf with leaf sheath and axillary bud explants were successfully regenerated shoots. Highest number and length of of shoots of leaf with leaf sheath explants were observed as 71±1.3 and 10.35±1.5 cm, respectively.

A radio sensitivity study by irradiating embryogenic calli with gamma ray (0, 7, 15, 21, 25, 30, 35, 40, 50 Gy) showed that the LD_{50} was 21 Gy. The irradiated calli were successfully regenerated into plantlets and acclimatized to external environment. Results of these studies could be very useful for mutation breeding of sugarcane.

1.3 Evaluation the performance on yield and yield contributing traits in 5 indigenous rice genotypes

M. H. Kabir, A. N. K. Mamun, M. R. Islam, M. T. Jahan, M. M. Islam, P. Das and M. M. Islam

Rice is a staple food for 166 million people in Bangladesh and the most important food crop in Asia and also the rest of the world. It provides 75% of total calories and 51% of protein in our population and also about 60% of the total agricultural Laboure force are engaged for rice production. It covers 77.96% of total cropped area in Bangladesh and contributing 14.6% of our national GDP. The average rice yield (2.5 t/ha to 3.0 t/ha) in the country is still low comparing to other rice growing countries in the world like China, Vietnum, Korea, Japan etc. where the average yield is 6.5 t/ha to 9.0 t/ha. The low yield performance of rice in the country is might be the effect of the cultivation of low yield potential genotypes, drought, unwanted flooding and soil

salinity. Based on the information mentioned above, the present study was undertaken to observe the yield and yield contributing traits among the 5 local rice genotypes for further improvement using gamma irradiation technique if needed. Many reports are available in induced mutation of rice for genetic improvements with higher yield and other agronomic traits. Seeds were sown in seed bed on June '17, transplanted on July '17 and harvested on November'17 at PBGED experimental field, IFRB, AERE, Savar, Dhaka. Plot size was 5.0 x 2.0 m^2 and distance between rows and plants were maintained 20 cm and 15 cm respectively. Recommended dose of fertilizers, cultural and intercultural practices were done as and when required. Porous pipe was depth into 15 cm of soil to maintain irrigation in rice field.

Results showed that highest yield was 5.2 t/ha in genotype B11 followed by 4.4 t/ha, 4.3 t/ha, 4.2 t/ha and 4.0 t/ha in genotypes of lombur, ashfal, kalampajam and hori respectively. Thousand grain weight was found maximum (33.2g) in the genotype ashfall and minimum (22g) was obtained in genotype hori. Highest number of tiller was found in the genotype ashfall whereas lowest tiller number was recorded in genotype kalampajam. The maximum (210 cm) plant height was attained in genotype ashfall and the minimum (148 cm) was attained ingenotype hori. Most of the genotype needed almost 5 months from seedling to harvesting of grains. Morphological observation revealed that almost all the genotypes exist tall culm and get lodging after bearing of panicle that resulted severe yield loss. On the other hand, all the genotype showed low yield potentiality and longer maturity period. Therefore, further study is needed to improve yield and agronomic traits using mutation breeding technique.

1.4 Optimization of doses for mutation induction on M_1 plants of country bean (*Phaseolus vulgaris* L.) using gamma irradiation

M. M. Islam, M. H. Kabir, P. Das, M. M. Islam and A. N. K. Mamun

Country bean (*Phaseolus vulgaris* L.) is an important pulse crop for its own nutritive values which belongs to the family leguminosae. The cultivated area is about 49,923 hectares of land and total production is about 1,28,676 mt with an average yield of 10-20m t/ha. In the beginning of agriculture, selection, migration and relative methods were used by breeders for the crop improvement. For the initiation of genetic diversity of plant species, selection and breeding studies have caused a serious contraction. So existing features of plants were improved using these methods in a certain stage. When limitation occurs than the related question arise how to overcome the problem. Mutation breeding is one of the important method that can solve these problem. It's a physical mutagen which is working on molecular level of plant materials and possible to create new variation in a short time. In the study, country bean seeds, variety BARI shem-1, were collected from Bangladesh Agriculture Research Institute (BARI). In the experiment 20 seeds were counted and placed in transparent petri dishes for each group. After counting seeds were irradiated at 8 doses levels viz. 50 Gy, 100 Gy, 150 Gy, 200 Gy, 250 Gy, 300 Gy, 350 Gy and 400Gy under ^{60}Co source in IFRB, AERE, Savar, Dhaka. Irradiated seeds were transplanted in the plot which was previously prepared well mixed soil with cow dung containing 1:1 ratio. Estimation of germination rate of country bean was done from the 7^{th} day after planting until the 14^{th} day. Than plant height were measured after being root harvested at the 30^{th} day.

In the present study showed that height seed germination were obtained with 50Gy gamma irradiation compare to other doses of gamma irradiation. In control 72.72% seed germination were showed because of its own genotype, seed viability, soil condition and overall environmental effects. Effects of low gamma doses were observed in our study, at the end of the 7th day the best seed germination percentage were obtained at 150 Gy gamma irradiation. At the end of 7^{th} day, percentage of seed germination increase gradually with gamma doses increase up to 150 Gy. In case irradiation group, the highest shoot (15.02 cm) and root length (7.12 cm) obtained at 50Gy dose level. It's clear that the growth of shoot and root length was inversely proportionate with irradiation dose levels. In the present investigation that the gradually decrease in vigour index from 1208 at 50Gy to 420 at 300Gy with increase of gamma dose levels. However the highest vigour index value recorded in control. These data also indicated that the root/shoot length ratio was decreased with the increase of irradiation dose, but the decrease was not proportional to the higher dose levels.

1.5 Clonal Propagation of *Stevia rebaudiana* Bertoni through axenic culture

M. T. Jahan, M. A. Islam, M. H. Kabir, M. R. Islam and A. N. K. Mamun

Stevia rebaudiana Bertoni is a rare medicinal herb belongs to the family Asteraceae. The plant is perennial, about 60-75 cm tall, leaf is sessile and oppositely arranged, flower is white and seed is very small. It is

originally a South American wild plant. This plant was cultivated hilly area in Paraguay. At first M.S. Bertoni was reported this plant in 1887. *S. rebaudiana* Bertoni is a sweet herb indigenous to the elated terrain of north eastern Paraguay near its borders with Brazil .The leaf extract of stevia is very sweet. The leaves of stevia are the source of the diterpene glycosides, viz. steviosides and rebaudiosides. Pure steviosides are non-caloric and 300 times sweeter than sugar. Now it is being cultivated in Japan, Taiwan, Philippines', Hawaii, Malaysia and over all South America for food and pharmaceutical products. The product can be added to tea, coffee, coke or beverages. Currently, about 750-1000 of *S. rebaudiana* are use by Japan, Brazil and other nations in variety of foods including soft drinks, sea foods, pickled vegetables etc. Seed of stevia show a very low germination percentage and vegetative propagation is limited by lower number of individuals. Propagation by seed does not produce homogenous populations; resulting in great variability is important feature like sweetening level and composition. Moreover, for commercial purpose when large scale propagation is necessary, the conventional way of production is not adequate to fulfill the required demand. Hence, there is a need to standardize a quicker method of propagation by *in vitro* culture techniques. So, tissue culture is only the alternative method for mass propagation of *S. rebaudiana*. Earlier *in vitro* propagation of stevia has been reported through different explants. The climatic condition, soil type of Bangladesh is very favorable for commercial propagation of this important plant. Considering its importance and to overcome the problem of its propagation through conventional methods, the present study was undertaken to develop a simple, rapid and economical protocol for the production of plantlets on a large scale from the node and shoot tip explants of *S. rebaudiana*.

A reliable rapid large scale micropropagation method has been established from the in vitro grown node and shoots tip explant of *Stevia rebaudiana* Bertoni. Experiments were conducted to standardize the culture media with plant hormone for multiple shoot proliferation and rooting for obtaining plantlets with uniform characteristics like mother plant in terms of growth and habits. Different concentrations and combinations of auxins (IAA) and cytokinins (BAP, Kin) were used in MS for the above purpose. Maximum shoot regeneration was found in MS treated with 2.0 mg/l BAP both in node and shoot tip explants. In the above combination, nodal explants produced 14-16 initial shoots. Shoot tip explants produced 10-12 shoots. For *in vitro* rooting, different concentrations of IBA and NAA were used. Higher rooting percentage was recorded on MS fortified with 0.5 mg/l IBA. The rooted plantlets were hardened and successfully established in the soil. About 85% of the regenerated plantlets survived in the natural condition.

1.6 Micropropagation in gladiolus (*Gladiolus imbricatus* L.cv. violet) using in vitro culture techniques

M. R. Islam, M. A. Islam, M. T. Jahan, M. H. Kabir and A. N. K. Mamun

Gladiolus is one of the major cut flower crops of the world and new cultivars are produced every year. It has also a great demand in the flower trade market in Bangladesh. Gladiolus is a monocotyledonous bulb crop which ranks fifth in cut flower sales worldwide. The genus Gladiolus includes 180 species with more than 10,000 cultivars of which about 20 are grown for commercial purposes. Gladiolus is generally multiplied vegetatively by seeds (Sexually) or corms. Improvement of Gladiolus using conventional methods did not produce desired results due to incidence of many diseases and environmental hazards; as a result the cultivars gradually degenerated. Moreover, seed derived plants normally do not yield true to type plants. It also requires four seasons for blooming. Through conventional methods, only limited numbers of corm are produced per plant and this are also time consuming. Beside these, for commercial purposes when large scale propagation is necessary, the conventional way of production is not adequate to fulfill the required demand. Hence, there is a need to develop a quicker method of a propagation which may be achieved through *in vitro* techniques. Propagation systems through enhanced axillary bud development, organogenesis and somatic embryogenesis have been reported for different species of Gladiolus.

Direct micropropagation system through organogenesis has been reported by several authors. Commercial floriculture of this colorful ornamental plant is spreading very extensively in the Jessor, Sathkhira, Gazipur and Savar region in Bangladesh. But no significant efforts have yet been made for mass scale propagation of this plant. Considering its importance and to overcome the problems of its propagation through conventional methods, the present study aimed at developing a rapid and efficient regeneration protocol from corm and cormel explant of *Gladiolus imbricatus* L. cv. Violet.

A protocol was developed for *in vitro* propagation of *Gladiolus imbricatus* L. cv. Violet using corm and cormel explant through the intervention of callus. Both the explants produced profuse callus when cultured on

MS containing 2.0 mg/l NAA. The induced calli were cultured on MS with BAP and 2ip singly or in combination with NAA for multiple shoot regeneration. Best response towards multiple shoot regeneration was observed from both corm and cormel explants derived calli on MS fortified with 1.0 mg/l BAP. In this combination, an average of 16 shoots was regenerated from cormel and 12 shoots were regenerated from the corm explant derived calli respectively. *In vitro* derived shoots produced profuse rooting within 30 to 35 days on MS containing 1.5 mg/l IBA. Well rooted plantlets were transferred to soil after proper hardening. About 80 to 90% plantlets were successfully established in the field condition.

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

Name of the participant	Title of the event	Organizer	Date	Place
All Scientist of this Division	National Biotechnology Fair-2018	National Institute of Biotechnology	7-8 sept. 2018	BSMR Novo Treatre

3. Collaboration Work(s)

Plant Biotechnology and Genetic Engineering Division (PBGED) has collaboration with International Atomic Energy Agency (IAEA), Regional Cooperative Agreement (RCA) Austria and Forum for Nuclear Cooperation in Agreement (FNCA), Japan. At present Scientists of this division engaged in several projects, these are as follows :

- Coordinated Research Project (CRP) of IAEA (No. 13186/RBF) entitled "Improvement of Banana (*Musa spp*.) through *in vitro* mutagenesis and doubled haploids"
- Forum for Nuclear Cooperation in Asia (FNCA) project entitled 'Induced mutation for higher protein, amylase and yield in salt tolerant rice landraces by gamma irradiation'
- Regional Cooperative Agreement (RCA) Project entitled 'Improvement of Crop Quality and Stress Tolerance for Sustainable Crop Production Using Mutation Techniques and Biotechnology (RAS/5/045)'
- Regional Cooperative Agreement (RCA) Project entitled RAS5056: "Supporting Mutation Breeding Approaches to Develop New Crop Varieties Adaptable to Climate Change (RCA)"
- Developing bio-energy crops to optimize marginal land productivity through mutation breeding and related techniques (RCA). (RAS 5070)
- Promoting the application of mutation techniques and related biotechnologies for the development of green crop verities. (RAS 5077)

INSTITUTE OF TISSUE BANKING AND BIOMATERIAL RESEARCH (ITBBR), AERE

Introduction

Each year throughout Bangladesh, thousands of people suffering from massive burns and surgical wounds require amniotic grafts for transplantation. Additionally, the stricken persons of the country have to embrace bone associated disability for the whole life due to traumatic complications need bone graft to treat. As a result, these two problems are the largest financial burden as this situation not only affect the family of patients but also cripple down national economy. However, institute of tissue banking in Bangladesh has undertaken the service program on the processing, preservation and clinical applications of amnion membrane and bone graft for rehabilitative surgery. Importantly, in recent years, this institute has started cranial bone autograft processing and transplantation. In accidental cases such as head injury, it is difficult to provide suitable cranial bone allograft according to demand. In this situation, injured cranial bone of the patient is being transported to the lab of the institute, where the scientist, tissue banker and medic work together immediately to process the cranial bone and sterilize by gamma radiation; and after quality assurance, the processed cranial bone autograft is being supplied for replacement surgery. The use of irradiated amnion and bone allografts and cranial bone autograft in reconstructive surgery restore normalcy to lives of many patients from disabilities. This tissue bank is based on finding and obtaining qualified donors from the community and a demand for tissue grafts from the hospitals. Although growing needs for tissue transplantation but raw and processed tissue grafts preservation and banking braces enormous logistical limitations. The only human tissue bank in Bangladesh, however, ensures the availability of tissue allografts of high quality and

acceptability to the recipients for rehabilitative surgery for a decade, regardless patients' socio-economic status. Moreover, this tissue bank arranges public and professional awareness programme to increase tissue donation. On top of that, tissue banking professionals work on the development of new biomaterial and allograft substitutes to mitigate the huge demand of graft material.

Activities

1. Research and Development Work(s)

1.1 Microbiological safety assurance of tissue allografts after radiation-sterilization

M. H. Adnan, M. L. Hossain, A. Siddika, F. Diba, M. Arifuzzaman, M. Z. Hasan and S. M. Asaduzzaman

Tissue bank, in simple words, works to provide tissue allografts for safe and effective transplantation. The risk of infectious disease transmission with human tissue grafts is a major concern in tissue banking practice. Non-sterilized, fresh or frozen bone allografts collected under aseptic conditions have been associated with transmission of viral infections such as HIV, hepatitis viruses (especially HCV and HBV) and bacterial infections. To minimize the hazard of infectious disease transmission, several steps are considered: careful donor screening and selection, proper tissue procurement, processing, preservation, storage and distribution. Even if these procedures are done under aseptic conditions, the possibility of bacterial and viral disease transmission of donor origin cannot be excluded. Therefore, sterilization of tissue allografts is strongly recommended. One of the most effective ways of sterilizing tissue allografts with little harm to the allografts is by irradiation. Radiation can inactivate the microorganisms in terms of their ability to regenerate or completely kill them. The results of radiation sterilization procedure depend on the amount of energy transferred, the number of contaminating microorganisms and their resistance to ionizing radiation. The radiation resistance of microorganisms is genetically determined. Usually spores are more resistant to radiation than the vegetative forms of bacteria, the most resistant fungi may be as resistant as bacterial spores, while viruses generally are more resistant than bacteria [3]. A dose of 25 kilo Gray (kGy) of gamma radiation is generally accepted as a suitable dose for sterilization of tissue allografts. The irradiated allogeneic tissues must not be a source of infection to recipients of allografts and, therefore, the sterility of tissue allografts must be ensured before supplying the allografts for clinical utilization. During the reporting period, 949 amnion samples from 36 batches and 936 bone samples from 40 batches were tested. The sample were supplied to the patients only after passing the sterility test.

1.2 The role of human amniotic membrane (HAM) in controlling multidrug resistant (MDR) bacteria isolated from burn patients

M. H. Adnan, M. L. Hossain, A. Siddika, M. Z. Hasan and S. M. Asaduzzaman

Some special features of Human Amniotic Membrane make it promising for tissue engineering applications. Such potential benefits of HAM in tissue engineering applications include its lack of immunogenicity and high antibacterial activity. In addition, it is easily available and cost-effective. This ideal scaffold has been used widely in wound dressing, ophthalmic and vaginal surgeries. Decellularization of the HAM has advantages such as enhancing its cell proliferation-supporting function and reducing its immunogenicity. Many studies have reported the antibacterial property of HAM and it promotes the healing of infected wounds. In recent years, the prevalence of antibiotic-resistant bacteria is increasing due to the indiscriminate use of antibiotics, especially in developing countries. Emergence of multidrug-resistant (MDR) strains has become a major concern in the health-care community. Therefore, a study is designed with a view to investigating whether HAMs (both fresh and decellularized) could be an effective antibacterial agent against MDR bacteria isolated from burn patients.

1.3 Isolation and characterization of microbes during frozen amniotic membrane allograft processing to ensure sterility for safe tissue banking practice

M. Arifuzzaman, M. L. Hossain, M. H. Adnan, A. Siddika, M. Z. Hasan and S. M. Asaduzzaman

Human Amniotic Membrane (HAM) is widely used as biological dressing material in reconstructive skin surgery, abdominal and vaginal reconstruction, plastic and cosmetic surgery and in ophthalmologic surgery. The objective of this study was to assess microbial quality of HAM during different stages of frozen HAM allograft processing and determination of antimicrobial susceptibility of isolated microorganisms. For this

purpose, twelve amniotic sacs were collected from normal vaginal delivery of seronegative mother from Azimpur maternity, Dhaka, Bangladesh. Initial bioburden was determined by using Nutrient Agar (NA), McConkey Agar, Eosin Methylene Blue (EMB) Agar, Potato Dextrose Agar (PDA). Total Viable Bacterial Count (TVBC) was calculated and Initial bacterial load was ranged from 39to 5.25 ×103. No fungus was found. A total 28 bacterial isolates were selected. These bacterial isolates were identified on the basis of cultural (e.g. colony size, shape, opacity), morphological (e.g. gram reaction, cell shape and arrangement) and biochemical characterization (e.g. catalase, oxidase, carbohydrate fermentation, Methyl Red (MR) test and Voges Proskauer (VP) test). Of them, eight bacterial isolates were identified as Staphylococcus aureus, two were Staphylococcus epidermidis, nine were Escherichia coli, three were Salmonella typhimurium, one was Enterobacter aerogenes, one was Pseudomonas aeruginosa, four were Acinetobacter baumanii. Then, antimicrobial susceptibility pattern of isolated microorganisms was determined against ten antibiotics which includes Amphicillin, Streptomycin, Gentamycin, Neomycin, Imipenem, Vancomycin, Cloxacillin, Polymixin-B, Penicillin-G and Ciprofoxacin. It was found that, all bacterial isolates were sensitive to streptomycin and Penicillin-G. Thus, Streptomycin-Penicillin-G (Strep-P) cocktail was formulated and was used for the preparation of frozen AM. Then, bioburden was again determined by spread plate technique using the same media. Bacterial load in the processed HAM were ranged from 33 to 3.94 2. After then, HAM was preserved by using Dulbeco's Modified Eagles Media (DMEM) and glycerol (1:1 ratio) and was stored at -80°C. Microbial quality of the preserved samples was checked at 07, 14, 21 & 30 days and no bioburden was found. Thus, it can be said that the antibiotic cocktail was suitable to remove the culturable microorganisms associated with HAM.

1.4 Determination of the characteristics of burn wound healing gel developed by the combination of human amniotic membrane and aloe vera extract

M. L. Hossain, A. Siddika, M. H. Adnan, M. Z. Hasan and S. M. Asaduzzaman

Skin burn wound is a notable medical burden worldwide. Rapid and effective treatment of burnt skin is vital to fasten wound closure and healing properly. Amniotic graft and Aloe vera are widely used as wound managing biomaterials. Sophisticated processing, high cost, availability, and the requirement of medics for transplantation limit the application of amnion grafts. We aim to prepare a novel gel from amnion combined with the Aloe vera extract for burn wound healing which overcome the limitations of graft.

Two percent human amniotic membrane (AM), Aloe vera (AV) and AM+AV gels were prepared. In vitro cytotoxicity, biocompatibility, cell attachment, proliferation, wound healing scratch assays were performed in presence of the distinct gels. After skin irritation study, second-degree burns were induced on dorsal region of Wistar rats; and gels were applied to observe the healing potential in vivo. Besides, macroscopical measurement of wound contraction and re-epithelialization; gel treated skin was histologically investigated by Hematoxylin and eosin (H&E) staining. Finally, quantitative assessment of angiogenesis, inflammation, and epithelialization was done. The gels were tested to be non-cytotoxic to nauplii and compatible with human blood and skin cells. Media containing 500 μg/mL AM+AV gel were observed to promote HaCaT and HFF1 cells attachment and proliferation. In vitro scratch assay demonstrated that AM+AV significantly accelerated wound closure through migration of HaCaT cells. No erythema and edema were observed in skin irritation experiments confirming the applicability of the gels. AV and AM+AV groups showed significantly accelerated wound closure through re-epithelialization and wound contraction with $P < 0.01$. Macroscopically, AM and AM+AV treated wound recovery rates were 87 and 90% respectively with $P < 0.05$. Histology analysis revealed significant epitheliazation and angiogenesis in AM+AV treated rats compared to control ($P < 0.05$). AM+AV treated wounds had thicker regenerated epidermis, increased number of blood vessels, and greater number of proliferating keratinocytes within the epidermis. We demonstrated that a gel consisting of a combination of amnion and Aloe vera extract has high efficacy as a burn wound healing product. Amniotic membrane combined with the carrier Aloe vera in gel format is easy to produce and to apply.

1.5 Development of biocompatible porous scaffolds based on hydroxyapatite/collagen/ chitosan composite for engineering of defected maxillofacial mandible bone

M. L. Hossain, M. H. Adnan, A. Siddika, M. Z. Hasan and S. M. Asaduzzaman

Fabrication of scaffolds from biomaterials for restoration of defected mandible bone has attained increased attention due to limited accessibility of natural bone for grafting. Hydroxyapatite (Ha), collagen type 1 (Col1)

and chitosan (Cs) are widely used biomaterials which could be fabricated as a scaffold to overcome the paucity of bone substitutes. Here, rabbit Col1, shrimp Cs and bovine Ha were extracted and characterized with respect to physicochemical properties. Following the biocompatibility, degradability and cytotoxicity tests for Ha, Col1 and Cs a hydroxyapatite/collagen/chitosan (Ha·Col1·Cs) scaffold was fabricated using thermally induced phase separation technique. This scaffold was cross-linked with (1) either glutaraldehyde (GTA), (2) de-hydrothermal treatment (DTH), (3) irradiation (IR) and (4) 2-hydroxyethyl methacrylate (HEMA), resulting in four independent types (Ha·Col1·Cs-GTA, Ha·Col1·Cs-IR, Ha·Col1·Cs-DTH and Ha·Col1·Cs-HEMA). The developed composite scaffolds were porous with 3D interconnected fiber microstructure. However, Ha·Col1·Cs-IR and Ha·Col1·Cs-GTA showed better hydrophilicity and biodegradability. All four scaffolds showed desirable blood biocompatibility without cytotoxicity for brine shrimp. In vitro studies in the presence of human amniotic fluid-derived mesenchymal stem cells revealed that Ha·Col1·Cs-IR and Ha·Col1·Cs-DHT scaffolds were non-cytotoxic and compatible for cell attachment, growth and mineralization. Further, grafting of Ha·Col1·Cs-IR and Ha·Col1·Cs-DHT was performed in a surgically created non-load-bearing rabbit maxillofacial mandible defect model. Histological and radiological observations indicated the restoration of defected bone. Ha·Col1·Cs-IR and Ha·Col1·Cs-DHT could be used as an alternative treatment in bone defects and may contribute to further development of scaffolds for bone tissue engineering.

1.6 Processing and preservation of cranial bone autograft for the reconstruction of skull defects

M. L. Hossain, M. H. Adnan, A. Siddika, M. Arifuzzaman, M. Z. Hasan and S. M. Asaduzzaman

Pathological defects or alterations in the shape of the calvarium may be caused by a number of processes, including traumatic defects, resection of benign or malignant tumors, congenital lesions, and iatrogenic injuries. The most common causes of skull defects include trauma, neurosurgical procedures and infections. It is a difficult task to re-implant autologous skull flaps due to its propensity for resorption. From July 2018 to June 2019, 38 frozen cranial bone autograft were supplied to the hospitals for cranial bone reconstruction. Using these autografts, patients suffering from traumatic head injury, brain tumor and stroke were treated successfully. Most of the patient underwent craniotomy because of traumatic head injury (THI) due to road-traffic accident (RTA).

1.7 Processing and preservation of amniotic membrane allografts for using it as wound healing dressing materials

M. L Hossain, A. Siddika, M. H. Adnan, M. Z. Hasan and S. M. Asaduzzaman

Human amniotic membrane is an ideal biological membrane or dressing due to its biological and biomechanical properties. It is readily available, inexpensive to procure and process. It can be procured from the placenta in normal vaginal deliveries and from Caesarean Sections. Processing is by freeze-drying or by air-drying process with sterilization using gamma irradiation. The product has low antigenicity, anti-microbial properties with ability to enhance epithelization with marked relief of pain. It is useful as a dressing for flap wounds, burn wounds, injury wounds, diabetic ulcers, leprous ulcers and post-surgery wounds and post-radiation wounds. It is also used as a biological scaffold for cells in tissue engineering. According to the demand of medical professionals, from July 2018 to June 2019, 6,552 pieces of radiation sterilized amnion membrane allografts (including eye grafts) were supplied to hospitals/clinics. Patients were successfully treated using these allografts suffering from various types of skin loss due to burn (acid, fire and electric burn), ophthalmologic defects, vaginal defects, abdominal wall reconstruction and some other complications.

1.8 Reconstruction of maxillofacial bone defects using gamma irradiated demineralized bone matrix

A. Siddika, M. L. Hossain, M. H. Adnan, M. Z. Hasan and S. M. Asaduzzaman

DBM is considered as a gift in the regeneration human periodontal defects. Demineralized bone matrix is allograft bone that has been decalcified to produce a product of collagen and noncollagenous proteins. The DBM provides both osteoinductive proteins and growth factors. Demineralization of bone is the first step during matrix breakdown, which improves accessibility of the growth factors that retain all or most of its osteoinductive potential. Demineralized bone matrix (DBM) is widely used in the repair of pathologies associated with skeletal defects and periodontal diseases. DBM powder is used primarily in periodontal applications. The property which sets demineralized bone matrix (DBM) grafts apart from other types of bone graft is its capacity to actively induce the formation of new bone. From July 2018 to June 2019, 84 vial demineralized bone granules have been supplied to the different hospitals/clinics throughout the country on

the basis of demand. The use of demineralized bone granules in oral and dental surgical procedures gave satisfactory clinical results. The processing of demineralized bone granules should be continued along with the processing of non-demineralized allogeneic bone grafts.

1.9 Processing, preservation of frozen massive bone allograft for clinical use in large skeletal defects after tumor surgery

A. Siddika, M. L. Hossain, M. H. Adnan, M. Z. Hasan and S. M. Asaduzzaman

In the management of malignant or locally aggressive bone tumors, limb-sparing surgery may be considered in most cases as an appropriate surgical treatment to achieve local tumor control. To restore skeletal continuity in large defects, different methods of reconstruction are currently used. Bone lengthening under continuous distraction is also possible in segmental defects. However, for young patients with a near-normal life expectancy, the implanted material is prone to loosening in the long term Preserved bone allograft, although it may initially be considered a biological non-living prosthesis, has the advantage of becoming progressively anchored by the host bone It can be stored deep-frozen for a long time and retains its original biomechanical properties after preservation. Bone allografting has attracted additional interest since it offers the possibility to restore an articular function by preserving the articular cartilage or serves as a structural support in failed prosthetic replacement. From July 2018 to June 2019, 6 deep frozen massive bone allografts have been supplied to the different hospitals/clinics throughout the country on the basis of demand. In this report, processing of frozen irradiated massive bone allografts for the reconstruction of long bone defects will be depicted.

1.10 Processing and preservation of cancellous chips allografts for treating osseous defects and augmentation of spinal fusion

F. Diba, M. L. Hossain, A. Siddika, M. H. Adnan, M. Arifuzzaman, M. Z. Hasan and S. M. Asaduzzaman

The human skeleton has a remarkable ability to regenerate itself after injury. This unique restorative capacity, shared perhaps with only the adult human liver, allows bones to heal at shapes, sizes and strengths essentially equal to their pre-injured forms. At its core, orthopaedic fracture care is an attempt to harness this amazing regenerative capacity and let the body do its work. Modern bone grafts, bone substitutes and bioactive factors attempt to facilitate and enhance the healing process when suboptimal conditions exist. Depending on their properties, preparation and application, bone grafts augment natural healing via osteoinductive, osteoconductive and/or osteogenic mechanisms. Cancellous bone allograft (CBA) alone or in combination with autologous bone precursor cells offers an appealing strategy for skeletal regeneration. In many cases, cancellous bones are preferable to cortical bone due to its higher surface area and open porous structure that allows for easy cellular penetration and incorporation. From July 2018 to June 2019, 16,328 cc bone grafts (including 6 deep frozen massive bone allografts have been supplied to the different hospitals/clinics throughout the country on the basis of demand. The processing and radiation sterilization of cancellous bone chips and the use of these allografts in the treatment of osseous defects in 2018 have been described in this report.

2. Seminar/Symposium/Conference/Meeting Attended

Name of the participant	Title of the event	Organizer	Date	Place
Dr. M. Z. Hasan	Workshop on the Access to Information (a2i)	Ministry of Science & Technology	06 -11 Jan. 2019	AERE, Savar
	World Stroke Congress- 2018	World Stroke Association	17-20 Oct. 2018	Montreal, Canada
	Electronic Government Procurement (e-GP) System	Ministry of Science & Technology	31 Mar.-4 Apr., 2019	AERE, Savar
M. L. Hossain	Nuclear Cyber Security Awareness Training	Nuclear Cyber Security Division (NCSD), ICS	12-13 Nov. 2018	AERE, Savar
A. Siddika	Nuclear and Radiological Emergency Preparedness Course	Bangladesh Atomic Energy Commission (BAEC)	25 Nov.- 6 Dec. 2018	AERE, Savar

3. Public and Professional Awareness

ITBBR arranges various awareness program throughout the country. People are being informed that tissue transplant surgeries improve life quality, even save life of thousands of people. But these miraculous surgeries are possible only because of the generosity of donor families and the commitment of people who make the decision to donate. A single tissue donor can save the life of several people. In our country, the majority people are familiar with the concept of blood transfusion and organ transplantation but the concept of tissue transplantation is somewhat new to them. To make the concept familiar and to inspire tissue donation seminars were arranged at different hospitals. Beside these discussion meeting with physicians are arranged regularly to increase professional awareness. The institute is doing its best for the improvement of human life and thus contributes a lot in the health sector.

4. Services Rendered and Revenue Income

Though started serving from earlier, regular supply of tissue allografts from this bank were documented at the end of 2006. From July 2018 to June 2019, 6,552 pieces of radiation sterilized amnion membrane allografts (including eye grafts) and 16,328 cc bone grafts (including 6 deep frozen massive bone allograft, 38 frozen cranial bone autograft and 84 vial demineralized bone granule) have been supplied to the different hospitals/clinics throughout the country on the basis of demand and earned TK. 8,60,260 (Eight lacs sisxty thousands two hundred sixty taka only). During this period, patients suffering from various types of skin loss due to burn (acid, fire and electric burn), leprotic ulcer, diabetic wounds, abdominal and vaginal complications and ophthalmic diseases were treated using amniotic membrane allografts. Using the bone allografts patients suffering from different orthopedic complications such as giant cell tumor, bone cyst, spinal defects, bone fracture, osteolytic lesion, fibrous dysplasia, gap-nonunion, osteosarcoma etc. were treated successfully.

NATIONAL INSTITUTE OF NUCLEAR MEDICINE & ALLIED SCIENCES (NINMAS), SHAHBAG

National Institute of Nuclear Medicine & Allied Sciences (NINMAS) is the apex Nuclear Medicine facility in Bangladesh and it is located in Bangabandhu Sheikh Mujib Medical University (BSMMU) premise. The Institutes provides medical imaging using nuclear techniques and therapeutic treatment services.

Objectives

- To render specialized medical services to the people using nuclear technology
- To improve and upgrade Nuclear Medicine facilities in Bangladesh
- To conduct training of physicians, physicists, radiopharmacists and technologists in the field of nuclear medicine
- To conduct academic and research activities
- To coordinate and standardize the activities of all nuclear medicine establishments of BAEC

Activities

1. Clinical Services

1.1 Diagnostic

- The Institute is equipped with 2 PET-CT facilities. PET-CT scan is very useful for early diagnosis and staging of cancer for the people of Bangladesh
- The institute is equipped with 3 SPECT facilities and one SPECT CT and one planar Gamma camera. The Scintigraphic studies are: Bone scan, Brain scan, Kidney (DTPA, DMSA), GFR, Hepatobiliary, HIDA, Lymphoscintigraphy, GI bleeding, Thyroid Scan, parathyroid, Salivary, Cardiac and Testicles, Lung Perfusion etc.
- Thyroid Imaging and Uptake
- BMD (Bone Mineral Densitometry) for early detection of osteoporosis/osteopenia
- Conventional and Power & Color Doppler ultrasound Imaging: At present there are 5 Color Doppler's including one 4D, one 3D and three 2D machines. All sorts of diagnostic USG, including normal B-scan of different organs, HRUS of superficial organs and Color Doppler of vascular system are routinely performed

- Hormone Analysis: All thyroids related hormones like T3, T4, TSH, FT3, FT4, LH, FSH, pituitary hormones, estrogen, progesterone, prolactin, testosterone, follicular stimulating and luteinizing hormones, Vitamin D, parathormone and Tumor Marker : Thyroglobulin, etc.

1.2 Therapeutic Activities

- The therapeutic component of our activity is extensively in the treatment of thyroid cancer and hyperthyroid patients using I-131
- Strontium-90 for pterygium, corneal neovascularization and squamous cell carcinoma of the conjunctiva
- I-131 labeled MIBG for diagnosis and therapy of neuroendocrine tumors

2. Academic

- NINMAS is the only institute in the country where postgraduate degrees like M. Phil and MD (Nuclear Medicine) courses have been conducted for the medical graduates under Bangabandhu Sheikh Mujib Medical University (BSMMU). Eight students passed M Phil course in the year 2018-2019 and nine residents were admitted for MD course of 5 years duration
- One Physician from abroad has been doing his MD (Nuclear Medicine) after completion his IAEA fellowship training in NINMAS
- During this period 8 students completed M Phil thesis supervised by the NINMAS personnel under BSMMU
- Three doctors completed their six months training program in the field of Nuclear Medicine & Ultrasound from this Institute
- Weekly journal review as continuous education program was conducted on recent Nuclear Medicine & Allied Sciences related works regularly in this institute
- Scheduled lectures were delivered routine to post graduate students (MD, MS) of different disciplines of BSMMU, BIRDEM, NIKDU, NICVD, NSH, NICRH, NICDH and Heart Foundation and students are placed for 15-30 days for practical demonstration

3. Manpower Development and Training Program

3.1 Training/Workshop/Seminar/Conferences Hosted

Title of the event	Organizer	Date	Place	No. of participants
Training Programme on "Dried Blood Spot (DBS) Sampling Procedure for the Screening of Congenital Hypothyroidism in Newborn Babies".	ADP Project "Screening of Congenital Hypothyroidism in Newborn Babies (Phase 2)".	20 Mar. 2019	NINMAS Dhaka	170
Scientific Seminar on "Newborn Screening for the Early Diagnosis and Treatment of Congenital Hypothyroidism".	ADP Project "Screening of Congenital Hypothyroidism in Newborn Babies (Phase 2)".	28 Apr. 2019	NINMAS Dhaka	180
Seminar on "Dementia Care: Role of Single Photon Emission Computed Tomography (SPECT) of Brain"	Society of Nuclear Medicine, Bangladesh (SNMB) and NINMAS	14 Nov. 2018	NINMAS Dhaka	150
IAEA Expert Assisted National Training Program on ''Clinical Application of PET-CT & Pediatric Nuclear Medicine	IAEA & NINMAS	01-05 Oct. 2018	NINMAS Dhaka	22
KOICA Assisted National Workshop on ''Nuclear Medicine and Remote Seminar of Nuclear Science''	KOICA& NINMAS	9 -12 Dec. 201	NINMAS Dhaka	35
Application Training on Philips Dual Modality PET – CT scanner with accessories at NINMAS	Philips, Bangladesh & NINMAS	13 -22 Jan. 2019	NINMAS Dhaka	22

Title of the event	Organizer	Date	Place	No. of participants
Application Training on Philips Dual Modality PET – CT scanner with accessories at NINMAS	Philips, Bangladesh & NINMAS	05- 10 Feb.2019	NINMAS Dhaka	30
Customer Training on Manual DELFIA (Victor 2D): Instrument Maintenance, Basic Trouble Shooting and Processing of TSH Assay	In vitro Division, NINMAS	25-28 Mar. 2019	NINMAS Dhaka	08

3.2 Training Attended

Name of the participant	Title of the event	Organizer	Date	Place
M. N. Hossain	Radiological and Nuclear Security: Prevention and response Training Course	INTERPOL	29 Apr.– 02 May 2019	Almaty, Kazakhstan
Dr. M. A. Azim	Training on "Procurement Entity (PE) User Module"	Central Procurement Unit (CPTU), IMED, Planning Ministry	5-7 Feb. 2019	Dohatec New Media, Dhaka
	Training on Project Management Information System (PMIS)	IMED, Planning Ministry	18 Dec. 2018	BAEC HQ, Dhaka
	2018 IAEAWCI-KAERI Training Course on Diagnostic and Therapeutic Radioisotopes and Radiopharmaceuticals Application	World Council of Isotope (WCI), KAERI and IAEA	22 Oct.-1 Nov. 2018	KAERI, Korea
	PPR 2008 and Public Procurement Management	Bangladesh Institute of Management (BIM)	16-27 Sept. 2018	BIM, Dhaka
	F2-TR-1807698: Regional Training Workshop on Production, Quality Control and Health Regulations for Radiopharmaceuticals	IAEA	3-7 June, 2019	Singapore General Hospital, Singapore
Dr. M. S. Ahsan Dr. T. Mandal	IAEA fellowship training under TC project FS-BGD6027 on "Strengthening Cancer Management through Capacity Building in Molecular Imaging Technology and Radiation Oncology"	IAEA	17 Sept.-16 Oct. 2018	Austin Health Hospital Australia
Dr. T. Mandal	Seminar on SPECT-CT, State of ART Nuclear Medicine Procedure –operational training & clinical application.	INMAS, Dhaka	4 Feb. 2019	INMAS, Dhaka
Dr. U. Islam	Training on Clinical PET-CT, Radiation Oncology and Targeted Radionuclide Therapy		22 -26 April, 2019	Royal Liverpool and Broadgreen University Hospitals, UK
Dr. F. Begum Dr. U. Islam Dr. J. Ferdous	Clinical Application of PET-CT and Pediatric Nuclear Medicine" Under IAEA TC Project (BGD6027)	NINMAS, BAEC & IAEA	01-05 Oct. 2018	NINMAS, Dhaka
All doctors, Physicists and technologists	Application Training on Philips Dual Modality PET – CT scanner with accessories at NINMAS	Philips, Bangladesh & NINMAS	13 -22 Jan. 2019 and 05-10 Feb. 2019	NINMAS, Dhaka
Md. A. K. Raju	Follow up Training Course (FTC) on Environmental Radioactivity Monitoring	BAEC and Japan Atomic Energy Agency (JAEA)	13-17 Jan. 2019	Training Institute, AERE, BAEC

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

Name of the participant	Title of the event	Organizer	Date	Place
Prof. Dr. N. Nahar, Prof. Dr. S. M. F. Begum, Prof. Dr. S. Sultana, Prof. Dr. M. N. Islam, Prof. Dr. J. A. Haque, Prof. F. Begum, Prof. Dr. F. Nasreen, Prof. Dr. Z. Jabin, Prof. Dr. A. B. Siddique, Prof. Dr. A. K. M. F. Bari, Prof. Dr. N. Sultana, M. N. Hossain, Dr. S. Quddus, Dr. M. A. Azim, Dr. S. Reaza, Dr. F. Haque, Dr. J. Ferdous, Dr. S. Salekin, Dr. P. Akhter, Dr. R. Perveen, Dr. T. Mandal, Dr. U. Islam, Dr. P. Bhattacharjee, N. Khatun, A. Parvin	24th National Conference of Society of Nuclear Medicine Bangladesh	Society of Nuclear Medicine, Bangladesh (SNMB)	22 Mar. 2019	Sonargaon Royal Resort, Narayanganj
Prof. F. Begum M. N. Hossain	The National Conference on Physics	Bangladesh Physical Society	07-09 Feb. 2018,	Dhaka University
All Doctors, Scientists & Technologists of NINMAS	Seminar on Care: Role of Single Photon Emission Tomography (SPECT) of Brain	SNMB & NINMAS	14 Nov. 2018	NINMAS
Prof. Dr. S. M. F. Begum, Prof. Dr. S. Sultana, Prof. Dr.M. N. Islam, Prof. Dr. F. Begum, Prof. Dr. J. A. Haque, Prof. F. Begum, Prof. Dr. F. Nasreen, Prof. Dr. M. A. B. Siddique, Prof. Dr. Z. Jabin, M. N. Hossain, Dr. M. A. Azim, Dr. M. S. Salekin, Dr. R. Perveen	KOICA Work Shop on Nuclear Medicine and Remote Seminar of Nuclear Science	KOICA Project & NINMAS, BAEC	9-12 Dec. 2018	NINMAS
Prof. Dr. F. Begum	Workshop Using BanglaJol Improving Journal Publishing Practices and Standards (JPPS)	INASP, JOL	7-8 Nov, 2018	Conference Room, BRAC Centre INN, Mohakhali
Prof. Dr. F. Nasreen	13th Asia Oceania Congress of Nuclear Medicine and Biology (AOCNMB 2019)	Asia Oceania Federation of Nuclear Medicine & Biology (AOFNMB)	9-11 May, 2019	Shanghai, China
Dr. M. A. Azim	Final Projects Review Meeting on RAS/6/082: Supporting the Applications of Emerging Targeted Therapeutic Radiopharmaceuticals for Radionuclide Therapy	IAEA	3-7 Dec. 2018	Putrajaya, Malaysia
Prof. Dr. S. M. F. Begum Dr. P. Mutsuddy	5th Theranostic World Congress 2019	Korean Association of Nuclear Medicine Promotion	1-3 March, 2019	Jeju, Korea
Dr. P. Mutsuddy	IAEA-INT6061-EVT1804082 Workshop	IAEA	5-9 Nov. 2018	Hwasun, Korea

Name of the participant	Title of the event	Organizer	Date	Place
	on Quality Management Audits in Nuclear Medicine Practices (QUANUM) Master's Course: Train the Trainors for Europe and Asia and the Pacific Region			
	57th Korean Nuclear Medicine Congress	KSNM	25-27 Oct. 2018	Seoul, Korea
	3rd International Congress of Osteoporosis	ICO	12-14 Oct. 2018	Seoul, Korea
Prof. Dr. N. Nahar Prof. Dr. S. M. F. Begum Prof. Dr. S. Sultana Prof. Dr. F. Begum Dr. P. Mutsuddy	Workshop entitled "Multidisciplinary Team Approach in Cancer Therapy: The Role of Nuclear Medicine."	KOICA/TEIN (Korea International Cooperation Agency/Trans-Eurasia Information Network)	9-13 Jul. 2018	Seoul, Korea
Dr. T. Mandal	Scientific seminar on New era of thyroid nodule treatment.	Bangladesh Thyroid Society	19 Dec. 2018	NINMAS, Dhaka
All doctors & Scientists of NINMAS	Scientific Seminar on Newborn Screening for the Early Diagnosis and treatment of Congenital Hypothyrodism	ADP Project "Screening of Congenital Hypothyroidism in Newborn Babies (Phase 2)	28 Aprl. 2019	NINMAS, Dhaka

5. Collaboration Work(s)

5.1 IAEA TC Project

- IAEA TC Project BGD2016003 "Improved Cancer Management through Capacity Building in Molecular Imaging and Radiation Oncology" (2018-19); Prof. Dr. Shamim Momtaz Ferdousi Begum

5.2 IAEA RCA Project

- Optimizing the role of Nuclear Medicine techniques in the diagnosis and clinical management of childhood cancer and inborn diseases (RAS/6/075); Prof. Dr. Sadia Sultana
- Preventing overweight and obesity promoting physical activity among children and adolescents (RAS/6/080); Prof. Dr. Shamim Momtaz Ferdousi Begum
- Improving Patients care & enhancing Government parties capacity in Nuclear Medicine Programs in RCA Region (RAS 6083); Prof. Dr. Jasmine Ara Haque
- Improving Quality of life of Cancer Patients through Steamline and Emerging Therapeutic Nuclear Medicine Techniques (RAS 6074); Prof. Dr. Jasmine Ara Haque

5.3 IAEA 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)"; Prof. Dr. Shamim Momtaz Ferdousi Begum
- CRP Project E13043 "Enhancing capacity of Neuroimaging & biomarkers: Application in early stage Alzheimer's disease with Comorbidities", Dr. Nasreen Sultana

5.4 Korea International Cooperation Agency Project

- KOICA (Korea International Cooperation Agency) project on "Infrastructure Strengthening of Nuclear Medicine in Bangladesh for Treatment of Non-communicable disease" 2018-2020; Local coordinator and advisor of Bangladesh: Prof. Dr. Shamim Momtaz Ferdousi Begum
- KOICA TEIN - Asi@Connect project "Enhancement of Nuclear Medicine Infra-structure using Asi@Connect in Bangladesh, 2018. Co Principal Investigator: Prof. Dr. Shamim Momtaz Ferdousi Begum

5.5 Ministry of Science & Technology Project

- Government ADP project "Establishment of Positron Emission Tomography Computed Tomography (PET-CT) Technology with Cyclotron facilities"; Project Director: Prof. Dr. Md Nurul Islam
- Government ADP Project: "Screening of Congenital Hypothyroidism in Newborn Babies (Phase 2)"; Project Director: Dr. Mohammad Anwar-Ul-Azim

6. Research and Development Work(s)

- Survey of Quality of life in thyroid carcinoma patients with long term levothyroxine supplementation; Prof. Dr. Fatima Begum and co-workers
- Pattern and analysis of high antiTgAb levels in Thyroid Carcinoma Patients; Prof. Dr. Fatima Begum and co-workers
- Estimation of Internal Exposure from Bioassay Sample of Nuclear Medicine Workers in NINMAS at Dhaka; Prof. Ferdoushi Begum and co-workers
- Assessment of concentrations and effective doses from urine samples of Nuclear Medicine workers in NINMAS, Dhaka, Prof Ferdoushi Begum and co-workers
- Evaluation of PET-CT in gastrointestinal carcinoma- Prof. Dr. Shamim Momtaz Ferdousi Begum, Dr. Abu Bakker Siddique and co-workers
- Role of PET-CT in evaluation of treatment response in lung carcinoma- Prof. Dr. Shamim Momtaz Ferdousi Begum and co-workers
- Experience of PET-CT in adult lymphoma- Prof. Dr. Fatima Begum and co-workers
- Experience of PET-CT in breast cancer- Prof. Dr. Shamim Momtaz Ferdousi Begum and co-workers
- 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. Mostofa Shamim Ahsan, Dr. Tapati Mandal and Dr. Pupree Mutsuddy
- Followup for intervention adopted in reversible perfusion defect in MPI- Prof. Dr. Shamim Momtaz Ferdousi Begum, Dr. Mostofa Shamim Ahsan, Dr. Tapati Mandal and Dr. Pupree Mutsuddy
- Correlation between parathyroid scintigraphy and ultrasonography in evaluation of parathyroid adenoma- Dr. Mostofa Shamim Ahsan and Dr. Sadia Salam
- DTPA renogram & USG of DM Patients more than 5yr - Prof. Dr. Jasmine Ara Haque & co workers
- Renal function tests of HTN patients more than 10 yrs by DTPA renogram – Prof. Dr. Jasmine Ara Haque & co workers
- Evaluation of renal function by MAG 3 under 1yr age patient – Prof. Dr. Jasmine Ara Haque & co workers
- Longterm Follow up of radioiodine treated thyroid carcinoma with lymphnodes metastases.
- Prof. Dr. Fatima Begum, Dr. Sharmin Quddus, Dr. Farhana Haque, Dr. Azmal Sarker, Dr. Sharmin Reza, Dr. Rahima Perveen and Dr. Urnas Islam
- Role of posttherapy scan in evaluation of hidden lungs metastases in patients with differentiated thyroid carcinoma- Dr. Sharmin Quddus, Dr. Farhana Haque, Dr. Azmal Sarker and Co-workers
- Spectrum of thyroid dysfunction in children who are referred to NINMAS for thyroid function evaluation- Dr. Simoon Salekin, Dr. Urnas Islam and co-workers
- Metastases in unusual sites from differentiated thyroid carcinoma-Dr. Rahima Perveen, Dr. Urnas Islam and co-workers

- Transvaginal folliculometry in infertile women- Prof. Dr. Jasmine Ara Haque and co-workers
- Evaluation of postmenopausal uterus by transvaginal scan- Prof. Dr. Jasmine Ara Haque and co-workers
- Biophysical profile on 32 weeks onwards pregnant women- Prof. Dr. Jasmine Ara Haque and co-workers
- Duplex study of vertebral arteries in patients- Dr. Fazlul Bari and co-workers
- Assessment of carotid vessels in DM and TIA – Dr. Nasreen Sultana and co-workers
- Musculoskeletal ultrasonography of different limb joints and injury- Dr. Fazlul Bari, Dr. Abu Bakker Siddique and co-workers
- Duplex study of uterine artery to predict pre- eclampsia. Case- control study. Dr. Abu Bakker Siddique and co-workers
- Duplex study of penile vessels in erectile dysfunction. (Pharmaceutical augmented). Dr. Abu Bakker Siddique, Dr. Fazlul Bari and Dr. Azmal Sarker
- Elastoscan of thyroid nodule- Dr. Fazlul Bari and co-workers
- Elastoscan of Breast- Prof. Dr. Jasmine Ara Haque and co-workers
- Less fetal movements and oligohydraamnios associated with high S/D ratio of umbilical artery Dr. Nasreen Sultana and co-workers

7. Service Rendered and Revenue Income

Nature/name of service	No. of patient/ sample	Income
No. of patients	76,922	
Blood sample analysis	34,947	6,47,98,030/-
Screening of Congenital Hypothyroidism in Newborn Babies Under the ADP Project "Screening of Congenital Hypothyroidism in Newborn Babies (Phase 2)"	26	80,000/-
Total		6,48,78,030/-

INSTITUTE OF NUCLEAR MEDICINE & ALLIED SCIENCES (INMAS), DHAKA

Introduction

Institute of Nuclear Medicine & Allied Sciences is one of the oldest Nuclear Medicine in this country and it was established in 1961 in the Dhaka Medical College premises. At present this institute included different technologies like PET-CT, SPECT-CT, Dual head & Single head Gamma Camera, thyroid scanner, 2D & 3D ultrasound scanner, Color Doppler scanner, BMD and in vitro procedure etc. significant number of patients health care services are offered from this institute as regular basis.

Activities

1. Manpower Development and Training Program

Title of the event	Date	Place	No. of participant
Weekly Seminar	Every Sunday	INMAS, Dhaka	15

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

Name of the participant	Title of the event	Organizer	Date	Place
Dr. F. S. Haque	24th National conference of Nuclear Medicine	SNMB	22 Mar. 2019	Narayongonj, Bangladesh
	22nd WFUM & 17th AFSUMB workshop	BSU	01-02 Mar. 2019	Dhaka, Bangladesh
	2nd International Congress on basics and advances in Obs & Gyn USG & workshop on International ovarian	Shristy Institute of Ultrasonography	21-22 Mar. 2019	Dhaka, Bangladesh

Name of the participant	Title of the event	Organizer	Date	Place
	tumor analysis-IOTA model			
	Seminar on SPECT-CT	INMAS, Dhaka	04 Feb. 2019	Dhaka, Bangladesh
	Seminar on New era of Management of thyroid nodule	NINMAS	19 Dec. 2018	Dhaka, Bangladesh
	30th National conference of BSU & workshop on musculoskeletal ultrasonography (part-2)	BSU	28-29 Sept. 2018	Dhaka, Bangladesh
	Workshop on musculoskeletal ultrasonography (part-1)	BSU	27 Jul. 2018	Dhaka, Bangladesh
Dr. R. Begum	24th National conference of SNMB	SNMB	22 Mar. 2019	Narayongonj, Bangladesh
	22nd WFUM & 17th AFSUMB workshop		01-02 Mar. 2019	Dhaka, Bangladesh
	2nd International Congress on basics and advances in Obs & Gyn USG & workshop on International ovarian tumor analysis-IOTA model	Shristy Institute of Ultrasonography	21-22 Feb. 2019	Dhaka, Bangladesh
	Seminar on SPECT-CT	INMAS, Dhaka	04 Feb. 2019	Dhaka, Bangladesh
	Seminar on New era Management of thyroid nodule	NINMAS	19 Dec. 2018	Dhaka, Bangladesh
	30th National conference of BSU & workshop on musculoskeletal ultrasonography (part-2)	BSU	28-29 Sept. 2018	Dhaka, Bangladesh
	Workshop on musculoskeletal ultrasonography (part-1)	BSU	27 Jul. 2018	Dhaka, Bangladesh
Dr. F. Rahman	24th National conference of Nuclear Medicine	SNMB	22 Mar. 2019	Narayongonj, Bangladesh
	Seminar on SPECT-CT	INMAS, Dhaka	04 Feb. 2019	Dhaka, Bangladesh
	Seminar on New era Management of thyroid nodule	NINMAS	19 Dec. 2018	Dhaka, Bangladesh
	Dementia Care: Role of SPECT of Brain	NINMAS	14 Nov. 2018	Dhaka, Bangladesh
Dr. A. Akhter	Long Term Training on "Infrastructure Strengthening Project of Nuclear Medicine in Bangladesh for Treatment of Non-communicable Disease"	KOICA Project (2018-2020)	26 Apr. 2018 – 25 Apr. 2019	Korea
Dr. S. Hossain	24th National conference of Nuclear Medicine	SNMB	22 Mar. 2019	Narayongonj, Bangladesh
	Seminar on SPECT-CT	INMAS, Dhaka	04 Feb. 2019	Dhaka, Bangladesh
	Seminar on New era Management of thyroid nodule	NINMAS	19 Dec. 2018	Dhaka, Bangladesh
	Dementia Care: Role of SPECT of Brain	NINMAS	14 Nov. 2018	Dhaka, Bangladesh
	Asia connecting workshop on nuclear medicine	QUAOICA & BAEC	9-12 Dec. 2018	Dhaka, Bangladesh
Dr. S. Sharmin	24th National conference of Nuclear Medicine	SNMB	22 Mar. 2019	Narayongonj, Bangladesh

Name of the participant	Title of the event	Organizer	Date	Place
	Seminar on SPECT-CT	INMAS, Dhaka	04 Feb. 2019	Dhaka, Bangladesh
	Dementia Care: Role of SPECT of Brain	NINMAS	14 Nov. 2018	Dhaka, Bangladesh
	IAEA expert assisted national training program on clinical application of PET-CT & pediatric nuclear medicine under IAEA TC project (BGD 6027)	NINMAS	01-05 Oct. 2018	Dhaka, Bangladesh

3. Collaboration Work/MoU

Title: Enhance Capacity of Institute of Nuclear Medicine & Allied Sciences, Dhaka

Project Director: Md. Zahangir Alom, Chief Engineer, BAEC, Dhaka

Renovation/Modification works of the existing building including false ceiling, plaster, RCC Works, floor tiles, wall tiles, plastic paint, distemper, weather coat, door, chowkat change, grill, sliding window, vantian blind etc. including electrical & electromechanical works.

4. Service Rendered and Revenue Income

Name of service	No. of patient/sample	Income
Patient service and sample analysis	49372	4,00,84,330/-

INSTITUTE OF NUCLEAR MEDICINE & ALLIED SCIENCES (INMAS), MITFORD

Introduction

INMAS, Mitford is situated in the campus of Sir Salimullah Medical College and Mitford Hospital Campus in the old part of Dhaka city.

Objectives

- Application of Nuclear technology in Medical services
- To improve and upgrade nuclear medicine facilities in Bangladesh
- To conduct academic and research activities

Activities

1. Clinical Services

1.1 Diagnostic Service

- Scintigraphic scan includes Bone scan, Cardiac MPI, Renal scan (DTPA, DMSA), HIDA scan, Hepatobiliary scan, Thyroid scan and Parathyroid scan, Lymphoscintigraphy
- All sort of diagnostic USG including conventional B-mode scan of different organ, HRUS of superficial organs and Color Duplex study of vascular system are routinely performed
- In Vitro diagnostic services includes hormone analysis like T_3, T_4, FT_3, FT_4, TSH, FSH, LH prolactine, testosterone, estrogen, progesterone. Different types of thyroid antibody and tumor marker Tg are routinely performed in this institute

1.2 Therapeutic Service

- Therapeutic activities include treatment of thyroid cancer and hyperthyroid patients using I-131

2. Research and Development Work(s)

- Dr. Afroza Naznin (Medical officer, INMAS, Mitford) doing her Ph.D research under Dhaka university on the topic "Effectiveness of Low Cost Portable Ultrasound Scanner for Telemedicine" (the study is going on)

- Dr. Ajmiratul Arshi (Department of Public Health, AIUB) Collect data from INMAS Mitford for her thesis paper titled "Knowledge regarding risk factors of Breast cancer among women attending a Tertiary Hospital in Dhaka"
- Dr AKM Farhad Hossain (NIPSOM, Dhaka) collect data from INMAS Mitford for his thesis paper titled " Perceived Stress and Health Related Quality of Life of Thyroid Cancer Patients"
- Md Ahshan Habib (Pabna University of Science and Technology) collect data from INMAS Mitford for his M.Sc thesis paper titled " Real –time Radiation Monitoring in INMAS Mitford Hospital campus by In-situ Method "
- In-house Research
- Effect of radio-iodine on salivary gland in Ca. Thyroid patient

3. Manpower Development and Training Program

Title of Event	Date	Place	No of participant
• জাতীয় শুদ্ধাচার কৌশল কর্ম পরিকল্পনা ও পরিবীক্ষণ কাঠামো ২০১৮-২০১৯ এর লক্ষ্যমাত্রা অর্জনের সূচকসমূহ • অফিস ব্যবস্থাপনা (শৃঙ্খলা ও মৌলিক আচরণ এবং নিয়মিত উপস্থিতি বিধিমালা-১৯৮২ (সকল কর্মকর্তা ও কর্মচারী) • উত্তম চর্চাসমূহ (Best Practises) অনুসরনের নির্দেশনা • অফিস ব্যবস্থাপনা • এপিএ ২০১৮-২০১৯ এর আবশ্যিক কৌশলগত উদ্দেশ্যসমূহ অবহিতকরণ • আর্থিক ব্যবস্থাপনা (প্রশাসন ও হিসাব বিভাগ) • Basic Concept of Computer Hardware • Operations of MS Word, MS Excel	3 days/month (Aug. 2018 – Jun. 2019)	INMAS Mitford	10 participant/ training course

4. Seminar/Conference/Workshop/Meeting Attended

Name of the participent	Title of the event	Organizer	Date	Place
Dr. H. A. Rahman Dr. J. Hossain Dr. A. K. Sarker	24th National Society of nuclear Medicine, Bangladesh	SNMB	22 Mar. 2019	Narayanganj, Bangladesh
Dr. H. A. Rahman	2nd International Congress on Basic & advances in OB-GYN Ultrasound and Workshop	Shristy Institute for Health Sciences	21-22 Feb. 2019	Green Tower. Dhanmondi, Dhaka
Dr. A. K. Sarker	KOICA Workshop on Nuclear Medicine and Remote Seminar of Nuclear Science	NINMAS, Dhaka	9-12 Dec. 2018	NINMAS, Dhaka
	DementiaCare:Role of SPECT of Brain	NINMAS	14th Nov. 2018	NINMAS, Dhaka
	5th Theranostics World Congress,	KAST	1-3 Mar. 2019	Jeju, South Korea
	KOICA/TEIN workshop on MDT approach in Cancer Therapy: The role of NM	KOICA/TEIN/Asi@Connect, EU	9-13 July, 2018	Seoul, South Korea
Dr. S. Sharmin	National Training Program on Clinical application of PET-CT and Pediatric Nuclear Medicine	NINMAS. (IAEA TC BGD 6027)	5 Oct. 2018	NINMAS, Dhaka

Name of the participent	Title of the event	Organizer	Date	Place
Dr. A. Naznin	New Era of Thyroid Nodule Treatment	Bangladesh Thyroid Society & NINMAS	19 Dec. 2018	NINMAS, Dhaka
M. F. Ahmed M. A.Hossain	State of art Nuclear medicine Procedure Operational Training & Clinical Application	INMAS, Dhaka	4 Feb. 2018	INMAS, Dhaka
M. S. I. Khan	Congenital Hypothyroidism screening for the nurses/technologists	NINMAS	20 Mar. 2018	NINMAS, Dhaka

5. Others

- Lectures are delivered to M.Phil/MD/MS students of different discipline of SSMCH, Mitford
- Lectures delivered to MD (Nuclear Medicine) students under BSMMUH
- Monthly in-house meeting and Seminar is held regularly

6. Service Rendered and Revenue Income

Name of service	No. of patient	Income
Patient Serrvice (USG, Scintigraphy, Radioiodine therapy, Follow-up of patients)	14,617	1,46,29,650/-
Blood Sample Analysis (Hormone analysis)	8,210	
Total	22,827	1,46,29,650/-

INSTITUTE OF NUCLEAR MEDICINE & 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, CT Scanner, Thyroid Scanner, Ultrasonogram, Colour Doppler and In-Vitro Laboratory for Radioimmunoassay (RIA) with Computerized Gamma Well Counter and other necessary facilities.

Activities/Program(s)

1. Services

1.1 Radionuclide imaging

Bone Scan, Renogram, Renal Scan, Thyroid Scan, Liver Scan, RBC Scan, parotid scan, testicular scan, parathyroid scan, HIDA scan etc.

1.2 Radionuclide Therapy

- Radio Iodine therapy for thyrotoxicosis and Ca-thyroid patients
- Radiation therapy after pterygium operation of eye

1.3 Radioimmunoassay

T3, T4, TSH, FT3, FT4, & TG and also several other hormones like LH, FSH, Prolactin, Testosterone, Progesterone, Oestradiole, AFP and Cortisol etc.

1.4 Ultrasound

- General Ultrasound (Whole Abdoment, Lower/Upper Abbomen, Pregnancy profile, HBS, KUB dtc.)
- High Reslution Ultrasound (Thyroid, Scrotum, Breast, Endocavitary Studies etc.)

1.5 Colour Doppler

Lower Limbs, Upper Limbs, Carotid Arteries, Testis, Pregnancy etc.

1.6 Thyroid Clinic

Thyroid cancer, hyperthyroidism, hypothyroidism patients came for treatment and follow up

2. Manpower Development and Training Program

Title of the event	Date	Place	No. of participant
Training on Medical Immunochemistry analyzer	15 July, 2018	INMAS, Ctg.	06
Training on ADIVA Centaur XPT operator and Maintenance	17-20 Sept. 2018	India	02
Training on ICT	2 Oct.-8 Nov. 2018	RPATC, Ctg.	02
Training on Mediso Dual Head Gamma Camera SPECT (AnyScan®S) and Gamma Camera System (TH-45)	3- 7 Dec. 2018	INMAS, Ctg.	04
Office Management and ICT Course	5-16 Aug. 2018	RPATC, Ctg.	01
Fundamental Training Course	11-29 Nov. 2018	RPATC, Ctg.	01
Application Training on Automatic Gamma Counter	3-8 Mar. 2019	INMAS, Ctg.	04
Training on e-Nothi	27 Jun. 2019	INMAS, Ctg.	08
Operational training on Single Head Gamma Camera	24-28 June, 2019	Hungary	01

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

Name of the participant	Title of the event	Organizer	Date	Place
Dr. P. K. Bhattacharjee Dr. M. S. Hossain	22 WFUMB Center of Education workshop & 17 AFSUMB workshop 2019	INMAS, Dhaka	1-2 Mar. 2019	INMAS, Dhaka

4. Other

- Sixteen students of Chattogram Polytechnique Institute participated in a three months Nuclear Medicine Instrumentations training in our Institute and successfully completed that training
- Twenty three students of Chattogram Institute of Medical Technology participated in a two weeks Nuclear Medicine Instrumentations training in our Institute and successfully completed that training

5. Service Rendered and Revenue Income

Name of Service	No. of patient	Income
Patient Service	55,693	3,49,36,450/-
Sample Analysis (including blood sample)	32,107	1,91,92,800/-

INSTITUTE OF NUCLEAR MEDICINE & ALLIED SCIENCES (INMAS), MYMENSINGH

Objective/Introduction

Institute of Nuclear Medicine and Allied Sciences (INMAS)**,** Mymensingh as an organization of Bangladesh Atomic Energy Commission is committed to peaceful use of Atomic Energy in the field of medicine. INMAS, Mymensingh has been started its work in 1989 using Nuclear technology in the 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. All the necessary in formations are in our own website www.inmasmym.org.

Activities/Program(s)

1. Medical Services

- Diagnosis and treatment of diseases

2. Research and Development Work(s)

- Developing facility to start post graduate MD residency course in Nuclear Medicine under BSMMU

3. Collaboration Work(s)

IAEA RCA Project "Strengthening Hybrid Imaging in Nuclear Medicine in Asia (RAS 6079)"

4. Lecture Delivered

- Series of lecture were arranged on SPECT-CT for doctors, scientist & scientific staff of INMAS, Mymensingh
- Series of lectures on radiation control and safety were held on during this period for scientific staffs of INMAS, Mymensingh
- Post graduate students of MD (Radiology & Imaging) and MS (Surgery, Pediatric surgery), Diploma Endocrine Medicine of MMC attended in a series of classes in this Institute based of Nuclear Medicine

5. Manpower Development/Training Program

Name of the participant	Title of the event	Date	Place	No. of participant
Dr. R. K. Chakraborty Dr. R. Ara	IAEA Expert Assisted National Training Program on Clinical Application of PET-CT & Pediatric Nuclear medicine (01 to 05 October 2018)	1-5 Oct. 2018	NINMAS	02
Dr. M. N. Khan Dr. R. Ara	Dementa Care : Role of Single Photon Emission Computed Tomography (SPECT) of Brain	14 Nov. 2018	NINMAS	02
Dr. R. Ara	State of ART Nuclear Medicine Procedure Operational Training & Clinical application	4 Feb. 2019	NINMAS	01
	Clinical impact of Myocardial Perfusion Scintigraphy in patients Coronary artery disease .	14 Feb. 2019	MMC	01
Dr. F. A. Dowel Dr. S. Z. Rima	Expert Assited KOICA Education workshop on Nuclear Medicine and Remote Seminar of Nuclear Science	09 Dec. 2018	NINMAS	02
Dr. F. A. Dowel M. A. Karim	Training course on Radiation protection in Nuclear Medicine practices	24-25 Mar. 2019	BAERA	02
Dr. M. Nadiruzzaman	Diagnostic and Prognostic impact of myocardial perfusion scintigaphy in patients with coronary artery disease.	14 Feb. 2019	MMCH	01

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

Name of the participant	Title of the event	Organizer	Date	Place
Dr. F. A. Dowel Dr. N. Nahar Dr. R. Ara	30th National Conference of the Bangladesh Society of Uttrasonograp	BSU	28 Sept. 2018	Dhaka
Dr. F. A. Dowel	20th WFUMB Center of Education Workshop			

Name of the participant	Title of the event	Organizer	Date	Place
Dr. R. K. Chakraborty Dr. R. Ara	on Diagnosis & Management of Fetal Anomalies part-2	BIRDEM	2 Mar. 2018	Dhaka
Dr. F. A. Dowel M. A. Awal M. Asaduzzaman	Scientific Seminar on Newborn sereening for the early diagnosis and treatment of congenital Hypothyroidism under the ADP project Screening of congenital Hypothyroidism in Newborn Babies (phase-l)	NINMAS	28 Apr. 2019	Dhaka
Dr. G. A. Hossain Dr. R. K. Chakraborty M. A. Karim	National Conference of Society of Nuclear Medicine Bangladesh (SNMB)	SNMB	22 Mar. 2019	Sonargoan Narayanganj
Dr. S. Z. Rima Dr. N. Nahar.	Scientific Seminar on New Era of Thyroid Nodule Treatment	NINMAS	19 Dec. 2018	Dhaka
Dr. S. Z. Rima	Monitoring of drug treatment and psychosocial intervention with SPECT in Alzheimer patients	INMAS Mymensingh	02 Mar. 2019	MMC Mymensingh

7. Others

- The Institute provides research facility for post graduate students of MD, MS, M Phil & PhD program
- Radioimmunoassay laboratory provide services to different research programs of different discipline of medical sciences
- This Institute provides facility to perform research program in association with other institutes such as MMC & BAU, Mymensingh

8. Service Rendered and Revenue Income

Name of service	Nature of service	No. of patient	Income
A lot of hormone assay by RIA Tumor marker assay by RIA, Radionuclide scanning of Brain, Bone, Kidney, Liver & Thyroid, Renography, Lymphoscintigraphy and Conventional Ultrasonography, Color Doppler studies, Interventional Ultrasonography	Diagnostic Service, Therapeutic Service	82812	55648300/-

INSTITUTE OF NUCLEAR MEDICINE & ALLIED SCIENCES (INMAS), SYLHET

Objective/Introduction

Institute of Nuclear Medicine & Allied Sciences, Sylhet is located at the North-East part of the country. It was established in the year of 1980 at Sylhet M.A.G Osmani Medical College campus. The institute provides both diagnostic and therapeutic services by using nuclear technologies & ultrasound system to improve the health care services to the people of greater Sylhet division. The institute also provides academic and research activities to upgrade the knowledge regarding nuclear medicine among the professionals.

Activities

1. Manpower Development/Training Program

Title of the event	Date	Place	No of participant
MD (Medicine) and MS (Surgery) Student of Sylhet M.A.G Osmani Medical College Completed their classes on Nuclear Medicine for 14 days	02-15 Jul. 2018 29 Oct.- 11 Nov. 2018 18-30 Nov. 2018 27 Nov.-10 Dec. 2018 9-15 Mar. 2019 01-15 May, 2019	INMAS, Sylhet	14

Title of the event	Date	Place	No of participant
Training on Government Service, Behavior, Rules & Discipline	29-31 July 2018	TI, Savar	03
RCO Training	5-9 Aug. 2018	TI, Savar	01
Training on Clinical Application of PET-CT & Pediatric Nuclear Medicine"	1-5 Oct. 2018	NINMAS, Dhaka	02
Application training on Mediso Dual Head Gamma Camera SPECT (Any scan) and Gamma camera System (TH-45)	3-7 Dec. 2018	INMAS, Chattogram	02
Training on Government Office Management and Skill Devolopment Training	16-17 Feb. 2019	BIM, Dhaka	01
E- Nathi Training	10-11 Mar. 2019	INMAS Sylhet	20
Training on Dried Blood Spot (DBS) Sampling Procedure For the Screening Of Congenital Hypothyroidism in Newborn Babies	20 Mar. 2019	NINMAS, Dhaka	01
Training course on Radiation Protection in Nuclear Medicine Practices	24-25 Mar. 2019	BAERA, Dhaka	01
Training on Government Office Management and Skill Development Training	22-23 May 2019	BIM, Dhaka	02
E-Nathi Training	22 June, 2019	INMAS Sylhet	13

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

Name of the participant	Title of the event	Organizer	Date	Place
Dr. M. M. A. Z. Bhuiyan	Workshop on Musculoskeletal Ultrasonography Part-1	The Bangladesh Society of Ultrasonography (BSU).	20 Jul. 2018	Hatirpool, Dhaka
Dr. K. Nahar	24th National Conference of Society of Nuclear Medicine Bangladesh (SNMB)	SNMB	22 Mar. 2019	Narayanganj, Dhaka
	Regional Workshop on Clinical Applications on Targeted Imaging and Therapy in Nuclear Medicine	IAEA	27-31 Aug. 2018	Amman, Jordan
	Dementia Care: Role of Single Photon Emission Computed Tomography (SPECT) of Brain,	NINMAS, Dhaka	14 Nov. 2018	NINMAS, Dhaka
	22nd WFUMB Center of Education Workshop & 17th AFSUMB Workshop on Leading Edge Ultrasonography	Asian Fedaration for Ultrasound In Medicine & Biology	1-2 Mar. 2019	NINMAS, Dhaka
	Clinical, Operational and Service Training on Dual Head SPECT-CT	Mediso Medical Imaging System Ltd.	5-12 Aprl. 2019	Budapest, Hungary
	Seminor on Newborn Screening for The Early Diagnosis and Treatment of Congenital Hypothyroidism	Under the ADP Project	28 Aprl. 2019	NINMAS, Dhaka
Dr. K. Nahar Dr. A. Naznin	30th National Conference of Bangladesh Society of Ultrasonography and Hands on Musculoskeletal Ultrasonography Part-2,	Bangladesh Society of Ultrasonography (BSU).	28-29 Sept. 2018	Hotel Purbani, International, Motijhil, Dhaka
Dr. K. Nahar M. I. Hossain	Seminar on SPECT-CT	INMAS, Dhaka	4 Feb. 2019	INMAS, Dhaka

3. Service Rendered and Revenue Income

No. of patient	Income
23449	13,465,450/-

INSTITUTE OF NUCLEAR MEDICINE & ALLIED SCIENCES (INMAS), RAJSHAHI

Objective/Introduction

Institute of Nuclear Medicine & Allied Sciences (INMAS), Rajshahi is located North West part of the country. This Institute provides services to the people of greater Rajshahi and nearby districts using nuclear technology and Ultrasound system and made a great impact in this region of the country for betterment of health services.

Activities/Program

1. Manpower Development and Training Program

Title of the event	Date	Place	No. of participant
MD (Medicine) and MS (Surgery) Students of Rajshahi Medical College were placed here for carried out their theoretical and practical classes for 14 days	03 Mar. -16 2019	INMAS, Ragshahi	4
Student of TMSS Medical Institute Research & Technology, Bogura Placed here for training their inplant training	19 Mar. 02 Apr. 2019	INMAS, Ragshahi	3

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

Name of the participant	Title of the event	Organizer	Date	Place
M. S. I. Chowdhury	Infrastructure strengthening project of Nuclear Medicine in Bangladesh for non-communicable disease	Seoul National University Hospital	28 Apr. 2018- 27 Apr. 2019	Korea
M. A. Mannan J. Hossain	Training on Dual Head SPECT Gamma camera & Thyroid Gamma Camera	INMAS,	19-23 Nov. 2018	Chattogram
Dr. M. S. Khatun	Expert Assisted KOICA Education workshop on Nuclear medicine and remote seminar of Nuclear Science	NINMAS	09-12 Dec. 2018	Dhaka
M. A. Mannan	Environmental Radioactivity Monitoring Course	TI, AERE	13-17 Jan. 2019	Savar, Dhaka
M. M. Rahman	Seminar on SPECT-CT	NINMAS	04 Feb. 2019	Dhaka
M. J. A. Khan M. N. Huda	Training on Automatic Gamma Counter	INMAS	03-07 Mar. 2019	Chattogram
Dr. M. S. Ahsan	Nuclear Medicine & Diagnostic Imaging	IAEA	17 Sept. 2017- 17 Oct. 2018	Australia
Dr. N. Begum Dr. M. M. Hossain	24th National Conference of SNMB	SNMB	22 Mar. 2019	Narayanganj
Dr. P. Ahmed M. A. Mannan	Radiation Protection in Nuclear Medicine Practices	BAERA	24-25 Mar. 2019	Dhaka

Name of the participant	Title of the event	Organizer	Date	Place
Dr. N. Begum M. A. Mannan	Operation & Clinical training on Dual Head SPECT Gamma Camera	M/S Mediso Ltd	1-12 Aprl. 2019	Hungary
Dr. M. S. Khatun	Infrastructure strengthening project of Nuclear Medicine in Bangladesh for non-communicable disease	SNUH	1 May 2019- Next one year	Korea
Dr. M. M. Hossain	Operational training on Single Head SPECT Gamma Camera	Hungary	24-28 Jun. 2019	Hungary

3. Repair & Maintenance and Renovation Works

Renovation works of old guest house, seminar room & Reception has done.

4. Service Rendered and Revenue Inccome

Name of service	No. of patient	Income
Patient service	34871	2,35,39,700/-
Sample Analysis(blood)	43024	

INSTITUTE OF NUCLEAR MEDICINE & ALLIED SCIENCES (INMAS), DINAJPUR

Objective/Introduction

Institute of Nuclear Medicine and Allied Sciences, Dinajpur was established in the year 1982 at Dinajpur Sadar Hospital campus to serve the endemic goiter zone of greater Dinajpur and Rangpur district. In the following decades the Institute served a huge number of patients with Thyroid Disorders. The main objective is to serve goitre affected person both in diagnosis and treatment. At the stage of establishment institute only confined to treat Thyrotoxic patient by 131-I but at present we also treat Thyroid Cancer affected person by 131-I ablation in a adition to toxic patient treatment. Thyroid disease related research activities also done in this institute for the last decades.

Activities/Program(s)

1. Research and Development Work(s)

Pattern of thyroid disorder among different age groups in Dinajpur: Nuclear medicine view

M**.** M. A. Hossain, M. S. Salekin, B. K. Bose and K. R. Rimi

Application of Nuclear Medicine technique in the diagnosis of Thyroid disorder play a major part in INMAS, Dinajpur which was established in 1982. Patients were referred here from different hospitals and private practitioners to evaluate the Thyroid gland and Thyroid hormone related disorders. 99_mTC pertechnetete Thyroid scan for thyroid scientigraphy, RIA and IRMA for hormonal assay are frequently performed procedures in our institure. We evaluate the different types of Thyroid disorder in Dinajpur, like simple goitre, diffuse toxic goitre, Multinodular goitre, either toxic or not, Thyroiditis etc. Dinajpur is a goitre prevalance zone and the incidence of Thyroid disorder is higher in female among female of middle age group. The common form of Thyroid disorder are iodine deficiency disorder (42.85%) in the age group of 7 to 20 yrs; toxic diffuse goitre (14.20%) in the age group of 20 to 40 years and non-toxic Multinodular goitre (31.73 %) in the age group of 40 to 80 years. In our study it reveals that Thyroid scientigraphy and hormonal assay can diagnose majority of Thyroid disorders especially IDD. Thyroiditis and diffuse toxic goitre.

2. Repair & Maintenance and Renovation Works

Under the project of "Enhancing Capacity of INMAS at Dhaka, Chattogram, Khulna, Sylhet, Rajshahi, Dinajpur and Rangpur" Renovation works is going on. Thyroid Uptake System, BMD Machine, Color Doppler Ultrasonography, Dual Head SPECT Machine also installed in the institute by this project.

3. Services

3.1 Diagnostic

In-vivo Technique

- Thyroid Scanner: This test is performed with thyroid scanner to determine the function of thyroid gland
- Nuclear Imaging: Diseases of bone, brain, liver, kidney, thyroid gland etc. are detected by taking images of the respective organs with SPECT machine
- BMD: Bone Mineral Densitometry (BMD) is used to assess bone mineral content of the patient for detection of osteoporosis and osteopenia
- Renogram: This test is performed with SPECT machine to determine the functional status of kidneys

In-vitro Technique

- Thyroid related hormones (T_3, T_4, TSH, FT_3, FT_4, Tg and Antithyroid Antibody) are being estimated in the lab by Radio Immunoassay (RIA) technique with modern instruments

Ultrasonogram with color Doppler

- Ultrasonogram both conventional and Color Doppler ultrasound available here

3.2 Therapeutic

- Radioactive Iodine (I-131) is used for treatment of thyrotoxicosis and thyroid cancer
- **Sr-90 is used after Pterygium operation of eye**

4. Manpower Development and Training Program

Title of the event	Date	Place	No. of participant
Clinical/Operational Training on Dual Head SPECT	1-12 Apr. 2018	Hungrary	02
Annual Meeting 2019 of Society of Nuclear Medicine and Molecular Imaging (SNMMI)	22-25 Jun. 2019	USA	01

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

Name of the participant	Title of the event	Organizer	Date	Place
Dr. J. B. Munni, Dr. S.M.W. A. Sarker, Dr. T. Islam, Dr. B. K. Bose, Dr. M. A. Mia, Dr. M. N. Islam and other Doctor	Seminar on "Radionuclide Management of Thyroid Disorders"	INMAS, Dinajpur	05 Feb. 2019	INMAS, Dinajpur
Dr. S. I. Mukta, Dr. I. Parveen, Dr. M. E. E. Sohag, Dr. B. K. Bose, Dr. M. A. Mia, Dr. M. N. Islam and other Doctor	Seminar on "Diagnosis of Osteoporosis by BMD"	INMAS, Dinajpur	08 May 2019	INMAS, Dinajpur

6. Collaboration Work/MoU

Reducing the shortage of oncology professionals through on applied sciences of oncology course (ASOC) – RAS/6/066 (RCA Project)

7. Service Rendered and Revenue Income

Name of service	No. of patient	Income
Patient Service	780	156000/-
Sample Analysis (including blood sample)	5437	4506850/-
Thyroid Scan, Ultrasonography and others	2154	1150550/-
Total	8371	5813400/-

INSTITUTE OF NUCLEAR MEDICINE & 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 Bogura & 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/Program(s)

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. Seminar/Symposium/Conference/Workshop/Meeting Attended

Name of the participant	Title of the event	Organizer	Date	Place
Dr. M. M. Ali	The Clinical Training on Color Doppler with 4D Ultrasound Project	Training	13-19 Oct. 2018	India
	Clinical, Operational and Service training of Dual Head SPECT-CT" at Mediso Imaging System Ltd.	Training	01-12 Apr. 2019	Budapest, Hungry
	Society of Nuclear Medicine and Molecular Imaging (SNMMI)-at during	Annual Meeting	22-25 Jun. 2019	Anaheim, California, USA
Dr. S. A. Choudhury	Regional Training Course On the Development and Clinical Application of Radiosynovecctomy Agents.	IAEA	14-18 Nov. 2016.	Quezon City in Philipines
M. S. Islamr	"Clinical, Operational and Service training of Dual Head SPECT-CT" at Mediso Imaging System Ltd.	Training	01-12 Apr. 2019	Budapest, Hungry
M. W. Ali	Operational Training program of the Single Head Gamma Camera	Training	24-28 Jun. 2019	Hungary

3. Academic Activities

- 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

4. Service Rendered and Revenue Income

Number of service	No. of patients	Income
Patient Service	20,133	1,07,82,300/-
Total		1,07,82,300/-

INSTITUTE OF NUCLEAR MEDICINE & ALLIED SCIENCES (INMAS), KHULNA

Objective/Introduction

- To Provide diagnostic and Therapeutic services to the patients using nuclear technology and ultrasound system and to conduct academic and research activities
- To promote better understanding of nuclear medicine services among the medical professional
- To improve and upgrade nuclear medicine facilities concerning local perspectives
- To facilitate research and development works in the relevant fields

Activities/Program

1. Research and Development Work(s)

- Value of assessing Carotid intima-media thickness using HRUS in patients with Subclinical and Clinical Hypothyroidism
- Pattern and distribution of Skeletal metastasis in common malignant tumour on Bone Scintigraphy-A prospective evaluation

2. Manpower Development and Training Program

Title of the event	Date	Place	No. of participant
In-house workshop on Nuclear Medicine Establishment Management (NMEM)	16 Aug. 2018	INMAS, Khulna	04
In-house workshop on "Maintenance of Nuclear Medicine Instruments"	8 Oct. 2018	INMAS, Khulna	11
In-house workshop on Online Patient Management System	3-4 Apr. 2019	INMAS, Khulna	07
In-house workshop on CC Camera and Fire Alarming System	9 Apr. 2019	INMAS, Khulna	17

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

Name of the participant	Title of the event	Organizer	Date	Place
Prof. Dr. A. K. Paul	24rd National Conference of SNMB	SNMB	22 Mar. 2019	Dhaka
	8th Khulna Divisional Medical Conference of BPMPA	BPMPA Khulna	06 Apr. 2019	Khulna
	Clinical Application of PET-CT Scan	INMAS Khulna	16 Apr. 2019	Khulna

4. Academic

- Post-graduate students and Internee doctors of Medicine Department, Khulna Medical College received training of Thyroid disease management from Thyroid Clinic
- Clinical students of Khulna Medical College, Students of Khulna University of Engineering and Technology and Khulna Polytechnique Institute were placed for theoretical and practical classes
- Arranged Seminar/Journal review on Nuclear Medicine, Ultrasound procedures and related subjects monthly

5. Service Renderd and Revenew Income

No. of Patient	Income
33,200	1,86,30,900/-

INSTITUTE OF NUCLEAR MEDICINE & ALLIED SCIENCES (INMAS), BARISHAL

Objective/Introduction

The Institute of Nuclear Medicine and Allied Sciences, Barishal is situated in the Campus of Sher-e-Bangla Medical College & Hospital. It was established in the year of 1989 with the objective to serve the people of the southern most part of the country. The Institute delivers its services mostly to the patients attending the Sher-e-Bangla Medical College Hospital and also to the people of the Barishal Division and as well as people of the neighbouring districts like Madaripur, Gopalgong, Pirojpur, Bagerhat etc. The Institute is equipped with one dual head SPECT and another single head gamma camera, one small organ scanner, thyroid uptake system and three ultrasonography machine with Colour Doppler, Elastoscan and 3D/4D facilities and a RIA Laboratory

1. Activities/Program

1.1 Diagnostic

- **Ultrasonography and Color Doppler**

Ultrasonography is the main diagnostic tool of the Institute. More than 50% of patients are handled through this system. Sonography of abdominal organs, thyroid gland, pediatric brain, testes, mammary gland, eye ball, joints, musculoskeletal system etc. are highly popular among the referring physicians. Colour doppler study of the peripheral vessels, carotid arteries and other organs is being done routinely. Elastoscan, endocavitary scan and 4D Ultrasonography of fetus & different organs are also done here.

- **RIA laboratory**

Serum T_3, T_4, TSH, FT_3, FT_4, FSH, LH, Prolactin, Progesterone, Testosterone, Tg, Anti TgAb, TPO Ab, TMAb are confidently estimated weekly and fortnightly

- **Nuclear Medicine**

Bone scan, Renal scan, Renogram, Liver-spleen scan, Hepatobiliary scan, Meckel's Scan, Thyroid scan, MIBI scan and whole body ^{131}I scans are routinely done

1.2 Therapeutic

- I-131 therapy: I-131 therapy is given to Hyperthyroid & Ca- thyroid patients
- Follow-up: Toxic & Ca-thyroid Patients are followed up periodically for the rest of their lives
- Beta-radiation: Beta-radiation is applied to Postoperative Pterygium patients using Sr-90 source

2. Research and Development Work(s)

- Outcome of radioiodine therapy in well differentiated Ca thyroid patients
- Incidence of congenital anomalies among the pregnant patients
- Normal splenic size in the Bangladeshi population
- Pathologies found in high resolution neck Ultrasonography

3. Repair and Maintenance Work

- Vertical extension work of 3rd floor with repair & maintenance of the rest of the building has been done
- Renovation of hot lab with L-bench, lead bin and lead syringes

4. Manpower Development and Training Program

Title of the event	Date	Place	No. of participant
Arranged In-house Training for Officer & Staff INMAS, Barishl	Aug. 2018 – May 2019	INMAS, Barishal	08 (Officer) 16 (Staff)
Honorary training course on Ultrasonography and Nuclear Medicine for doctors	July, 2018 – Jun. 2019	INMAS, Barishal	2

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

Name of the participant	Title of the event	Organizer	Date	Place
Dr. N. Jahan	24nd National Conference of Society of Nuclear Medicine Bangladesh (SNMB)	SNMB	22 Mar. 2019	Sonargaon, Narayanganj
	Regional Workshop on Clinical Application on Targeted Imaging and Therapy in Nuclear Medicine (Theranostics) (RAS6091)	IAEA	27-31 Aug. 2018	Amman Jordan
	Hands-on Musculoskeletal Ultrasonography (Part-2)	BSU	29 Sept. 2018	Dhaka
	KOICA Workshop on Nuclear Medicine and Remote	KOICA and	09-12	NINMAS,

Name of the participant	Title of the event	Organizer	Date	Place
	Seminar of Nuclear Science	BAEC	Dec. 2018	Shabag, Dhaka
	Government Office Management & Efficient Development Course	BIM	16-17 Feb. 2018	BIM, Dhaka
Dr. F. Sharmin	Hands-on Musculoskeletal Ultrasonography (Part-2)	BSU	29 Sept. 2018	Dhaka
	Clinical Application on PET-CT & Pediatric Nuclear Medicine	IAEA	01-05 Oct. 2018	NINMAS, Dhaka
	30th National Conference of The Society of Ultrasound	BSU	28 Sept. 2018	Dhaka
Dr. N. Jahan	KOICA Workshop on Nuclear Medicine and Remote Seminar of Nuclear Science	KOICA and BAEC	09-12 Dec. 2018	NINMAS, Dhaka
Dr. T. Ahmed	Achieving Sustainable Development Goals in Bangladesh (ASDGB)	BPATC	01-05 Jul. 2018	BPATC, Savar, Dhaka
	24nd National Conference of Society of Nuclear Medicine Bangladesh (SNMB).	SNMB	22 Mar. 2019	Sonargaon, Narayanganj
D. S. Kumar	Practical Income Tax & VAT Management	BIM	23 Sept.-4 Oct. 2018	BIM, Dhaka
M. M. U. Alhmahomud	Achieving Sustainable Development Goals in Bangladesh (ASDGB)	BPATC	01-5 Jul. 2018	BPATC, Savar, Dhaka
	Training of Presiding officer- City Corporation Election, Barishal-2018 dated on 30 July 2019	Election Commission	26 Jul. 2018	Govt. Syed Hatem Ali College, Barishal
	Government Office Management & Efficient Development Course	BIM	2-3 Nov. 2018	BIM, Dhaka
M. Rahman	Attended The training on "Dried Blood Spot(DBS) Sampling Procedure for the Screening of Congenital Hypothyroidism in Newborn Babies"	BAEC & NINMAS	20 Mar. 2019	NINMAS, Shahbag, Dhaka

6. Collaboration Work(s)

Institutes collects blood samples from the newborn babies as part of country wide screening of neonatal congenital hypothyroidism program under the National ADP project‘ Screening of Congenital Hypothyroidism in newborn babies (phase-2).

7. Others

Review of journals on nuclear medicine and Ultrasonography procedures on monthly basis.

8. Service Rendered and Revenue Income

Number of service given organization/person/patient	Total number of patient	Income
Patient service	27531	1,46,00,550/-

INSTITUTE OF NUCLEAR MEDICINE & ALLIED SCIENCES (INMAS), FARIDPUR

Introduction

Institute of Nuclear Medicine & Allied Science (INMAS), Faridpur was established along with other three institute in Mitford, Commilla and Bogura as a common project. The institute is situated in the premises of Faridpur medical college hospital. The foundation stone was led on 15 September 1995, construction was completed in early 1997 and the institute started running in October 1997. Patients from greater Faridpur district and adjacent areas usually attend the institute to receive nuclear medicine services.

Activities

1. Services

- Rendar diagnostic and therapeutic service to the patients. A large number of patients attend the institute for different kinds of ultrasonogram, thyroid function studies, radioisotope scan and for estimation of different other hormones. Also render therapy for thyrotroxicosis and ca-thyroid patients

2. Research and Development Work(s)

- Duplex study of carotid arteries in normal individuals to determine normal range and variations
- Study of ovulation by ultrasound in female infertility
- Duplex study of pregnancy for early detection of IUGR

3. Manpower Development and Training Program

- In house training on "Basic Nuclear Medicine and administration" arranges in INMAS, Faridpur 3-13 Sep 2018
- Office management and ICT course at RPATC, Dhaka completed by Md Nazrul Islam Khan, Acountant, 9-20 Sep 2018

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

Name of the participant	Title of the event	Organizer	Date	Place
Dr S. K. Dey	Workshop on understanding CT scan role in hybrid imaging, Osaka, Japan, 01-05 Oct 2018	Osaka University hospital	01-05 Oct 2018	Osaka, Japan
Dr. H. Rahman	24th National Conference of SNMB	SNMB	22 Mar. 2019	Sonargoan , Dhaka
Dr. I. Hossain M. S. I. Khan	Seminar on SPECT-CT	INMAS, Dhaka	4 Feb. 2019	Dhaka
A. Begum	Seminar on Dimentia care, role of SPECT of brain. 22th National conference of the "Society of nuclear medicine, Bangladesh"	NINMAS, Dhaka	14 Nov. 2018	Dhaka

5. Public Awareness

Booklets and posters were published for public awareness and distributed during "National Unnyan Mela".

6. Service Rendered and Revenue Income

Name of the service	No. of patient	Income
Blood sample study for hormones	12561	89,79,405/-
Ultrasound and Doppler, Scintigraphy, radioiodine therapy	8636	34,49,345/-
Total	21197	12428750/-

INSTITUTE OF NUCLEAR MEDICINE & ALLIED SCIENCES (INMAS), BOGURA

Objective/Introduction

The Institute of Nuclear Medicine & Allied Sciences, Bogura is a government institute of specialized and applicable research oriented health services. The government fund and labors are totally used here for public health service and mankind. The main objective of the Institute is to apply Atomic Energy in a safe and peaceful way for the well being of mankind, rather than to use it in destruction. The Institutue is mainly involved with diagnosis and treatment of various human diseases using radiopharmaceuticals. Academic and research activities are also performed here. Gamma Camera. Thyroid Uptake System, Gamma counter, Pterygium Applicator, Ultra sonogram and other associated ultra-modern equipments are available in this Institutue.

Activities/Program(s)

1. Services

1.1 Diagnosis

- Radioisotope Scan: 1. Brain Scan, 2. Kidney Scan, 3. Liver- spleen Scan
- Bone Scan, 5. Hepatobiliary Scan, 6. Thyroid Scan, 7. Ranogram etc.
- Radio-immuno assay (RIA) : T3, T4, TSH, FT3, FT4, Tg, Anti Tg, Anti TPO, Prolactin, FSH, LH
- Ultrasonogram

1.2 Treatment/Therapy

- Radio-iodine ablation of post-operative therapy cancer and therapy of Hyperthyroidism
- Beta-Radiation in postoperative pterygium to prevent recurrence of disease

2. Academic Activities

- Lecture/demonstration to the students of Shaheed Ziaur Rahman Medical College and
- Institute of Health Technology, Bogura about the role and procedures of Nuclear Medicine

3. Human Resource Development and Training Program

- Internal Training is delivered regularly to the officer and staffs for human resource
- Development

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

Name of the Participant	Title of the event	Organizer	Date	Place
M. S. Rahman M. Z. Hassan	চাকুরির আচরণবিধি ও নিয়ম-শৃঙ্খলা সংক্রান্ত প্রশিক্ষণ কোর্স	TI, AERE	29 -31 Jul. 2018	Savar
Dr. M. A. Awal	Training Program: Fundamentals of Radioisotopes and Radiation Technology	KOICA-IAEA-KAERI	09-22 Sept. 2018	Korea
	Training Program: TC Workshop on Understanding CT Scan Role in Hybrid Imaging (PET/CT and SPECT/CT)	IAEA	01-05 Oct. 2018	Japan
M. F. Hossain	Use maintenance and trouble shooting of Common Laboratory Equipment	NITUB	27 Oct. -01 Nov. 2018	Dinajpur
	Expert Assisted KOICA Education Workshop on Nuclear Medicine and Remote Seminar of Nuclear Science	NINMAS	09 -12 Dec. 2018	Dhaka
	Radiation Protection in Nuclear Medicine Practices	BAERA	24-25 Mar. 2019	Dhaka
	বার্ষিক কর্মসম্পাদন চুক্তি (এপিএ) ২০১৯-২০২০" স্বাক্ষর ও বাস্তবায়নের লক্ষ্যে আলোচনা সভা	BAEC	30 Apr. 2019	Dhaka
M M. Islam M. S. Rahman	সরকারী অফিস ব্যবস্থাপনা ও দক্ষতা উন্নয়ন	BIM	16- 17 Feb. 2019	Dhaka
M. Z. Alam	Dried Blood Spot (DBS) Sampling Procedure for the Screening of Congenital Hypothyroidism in Newborn Babies	NINMS	20 Mar. 2019	Dhaka
Dr. S. A. Chowdhury	Infrastructure Strengthening project of Nuclear Medicine in Bangladesh for Treatment of Non-communicable diseases (Long term Training)	KOICA Project	27 - 26 Apr. 2019	Korea
M. A. Mamun	Screening of Congenital Hypothyroidism in Newbron Babies (Phase-2)	NINMS	28 Apr. 2019	Dhaka

Name of the Participant	Title of the event	Organizer	Date	Place
Dr. M. A. Awal, M. A. Ali, M. A. S. Akond, M. A. Matin, M. J. Sarkar, M. J. Haque	24 Th National Conference (SNMB)	SNMB	13 - 17 May 2019	Dhaka

5. Service Rendered and Revenue Income

Name of Service Provided	No. of Sample/patient	Income
Patient Service	8913	44,99,300/-
Sample Analysis (including blood sample)	10288	82,84,800/-
Total	19201	1,27,84,100/-

INSTITUTE OF NUCLEAR MEDICINE & ALLIED SCIENCES (INMAS), CUMILLA

Activities/Program

1. Manpower Development/Training Program

Title of the event	Date	Place	No. of Participant
চাকুরীর আচরণবিধি ও নিয়ম-শৃঙ্খলা সংক্রান্ত প্রশিক্ষণ কোর্স	23- 25 Jul. 2018	TI, AERE	02
Train the Trainers Course for Radiation Protection in Interventional Radiology Chulalingkorn University Faculty of Medicine Department of Bangkok, Thailand.	03- 10 Feb. 2018	Thailand	01
FTC on Nuclear and Radiological Emergency Preparedness December/2018	01 Apr. – 31 May 2018	TI, AERE	01
Radiation Protection in Nuclear Medicine Practices	24 – 25 Mar. 2019	Dhaka	02
SPET-CT	04 Feb. 2019	Dhaka	01

2. Service Renderd and Revenue Income

Name of Service	No. of patient	Income
Patient Service (USG, RIA, Scan, Therapy, Follow Up etc.)	19,406	1,13,91,450/-

INSTITUTE OF NUCLEAR MEDICINE & ALLIED SCIENCES (INMAS), COX'S BAZAR

Objective

Objective/Introduction

- Ensure safe and peaceful use of nuclear energ
- Expanding the use of nuclear technology in medical care
- Increase research Competence in the field of Science and technology

Activities

1. Manpower Development and Training Program

Title of the event	Date	Place	No. of participant
In-house training course on office manners and general behavour	15-19 jun. 2019	INMAS, Cox's Bazar	14

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

Name of the participant	Title of the event	Organizer	Date	Place
Dr. M. S. Alam	PET-CTW paediatric nuclear medicine.	NINMAS	1-5 Oct, 2018	Dhaka

3. Service Rendered and Revenue Income

Name of service	No. of patien/samples	Income
Patient Service	3588	18,45,250/-
Sample Analysis (including blood sample)	4852	
Total		18,45,250/-

III. ENGINEERING AND GENERAL SERVICES

ENGINEERING DIVISION (ED), HQ

Introduction

Bangladesh Atomic Energy Commission has been engaged in research and development (R & D) activities in the various fields of Nuclear Science and Technology in the country. Under the Charter of Bangladesh Atomic Energy Commission, Engineering Division (ED) has been entrusted with the responsibilities for installation, testing and operation of various scientific, nuclear and engineering facilities and building up & maintenance of physical infrastructures for smooth operation of R&D programs of BAEC. This division is also actively involved in the implementation of 2400 MW Rooppur Nuclear Power Project (RNPP) at Pabna.

Activities

1. Contribution in implementing of various ADP projects (both completed and ongoing)

1.1 Works contributing under the project "Enhance Capacity of Institute of Nuclear Medicine and Allied Sciences (INMAS) at Dhaka, Chattogram, Khulna, Sylhet, Rajshahi, Dinajpur and Rangpur"are as follows:

- Planning, Designing, Estimating and supervision of renovation of old INMAS buildings
- Construction of six storied new building in Dinajpur, three storied in Khulna and Rajshahi, one storied in Chattogram and also vertical extension in Rangpur
- Construction and installation of lift, AC, Sub-station are in progress

1.2 Works contributing under the project "Modernization of Food and Radiation Biology Facilities" AERE, Savar are 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

1.3 Works for Planning, Designing, Estimating and Construction of Three Storied new residential building under the project "Development of Human Resources & Establishment of Residential Accommodation Facilities for the Radiation Testing and Monitoring Laboratory", at Mongla

1.4 Works for Planning, Designing, Estimating and Construction of eight new buildings under the project "Establishment of Institute of Nuclear Medicine and Allied Sciences (INMAS) at 8 Medical Collage Hospital Campuses in the country "at Dhaka, Khustia, Jessore, Cox's Bazar, Gopalgonj, Pabna, Satkhirah

1.5 Works contributed under the project "Capacity build-up of Nano and Nano-bio Technological laboratory" at Materials Science Division, AEC, Dhaka are as follows:-

- Planning, Designing and estimation for renovation of Laboratories of materials science division at AECD
- Installation, Testing and commissioning of Air Conditioning system and other electrical works

1.6 Works contributed under the project "Establishment of Positron Emission Tomography–Computed Tomography (PET-CT) with Cyclotron facilities" at AERE, Savar are as follows:-

- Installation, Testing and commissioning of 1000KVA new Sub-station
- Installation, Testing and commissioning of 300KVA generator

1.7 Similar works contributed for the project "Balancing, Modernization, Refurbishment and Extension (BMRE) of Safety Systems of the 3 MW TRIGA Mark-II Research Reactor Facilities"

1.8 Similar works contributed for the project "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"

1.9 Similar works contributed for the project "Establishment of Calibration and Quality Control Facilities for Radiotherapy, Diagnostic Radiology and Neutron"

2. Works Accomplished Under Revenue Budget

2.1 At BAEC, HQ

- Replacement of Combi-closet, hand wash basin, false ceiling venetian blinds for office room of member (Bio Science) at BAEC, Paramanu Bhaban, HQ, Agargaon, Dhaka
- Supply, Installation, Testing & Commissioning Optical Fiber Cable and other accessories at BAEC, HQ, Agargaon, Dhaka
- Supply, Installation, testing & Commissioning of Cassette type Air Conditioner and Door air curtain at BAEC, HQ, Agargaon, Dhaka
- Monthly Maintenance Service 100MBPS Hi-Speed Internet Bandwidth Supply, connection and installation at BAEC, HQ
- Supply, installation, Testing and Commissioning of Bag Scanning Machine at BAEC, Paramanu Bhaban, HQ, Agargaon, Dhaka
- Supply, construction, installation, testing and commissioning of 750-8000kg (8passengers) observation lift for BAEC Conference Centre [former canteen building] at BAEC, Paramanu Bhaban, HQ, Agargaon, Dhaka
- Supply, Installation, Testing and Running of Heavy Duty Photocopier Machine at Engineering Division, at BAEC, Paramanu Bhaban, HQ, Agargaon, Dhaka
- Manufacturing and Supplying of sofa sets for Nuclear Safety, Security & Safeguard Division at BAEC, Paramanu Bhaban, HQ, Agargaon, Dhaka
- Manufacturing and Supplying of Office furniture's for Member Bio Science at BAEC, Paramanu Bhaban, HQ, Agargaon, Dhaka
- Dismantling, Servicing and new Supply, installation, Testing & Commissioning of Split Type Air Conditioner at BAEC, Paramanu Bhaban, HQ, Agargaon, Dhaka
- Painting works at BAEC, Paramanu Bhaban, HQ, Agargaon, Dhaka
- Supply, Installation, Testing & Commissioning of Split Type 5 Ton Air Conditioner at BAEC, Paramanu Bhaban, HQ, Agargaon, Dhaka
- Supply, installation, Testing &Running of P6 Display Screen at BAEC, Paramanu Bhaban, HQ, Agargaon, Dhaka
- Supply, Installation, Testing & Commissioning of Split Type Air Conditioners at BAEC, Paramanu Bhaban, HQ, Agargaon, Dhaka
- Renovation and Modification works of Room 707 [8 INMAS Project part], 6th Floor, at BAEC, ParamanuBhaban, HQ , Agargaon, Dhaka
- Supply, Installation, Testing & Commissioning of Split Type Air Conditioners at BAEC, Paramanu Bhaban, HQ, Agargaon, Dhaka
- Renovation and modification Works of Room No-705, 6th floor at BAEC, Paramanu Bhaban, HQ, Agargaon, Dhaka
- Renovation and modification works of Room No-610, 5th Floor at BAEC, Paramanu Bhaban, HQ, Agargaon, Dhaka
- Supplying of Electrical Goods for at BAEC, Paramanu Bhaban, HQ, Agargaon, Dhaka

- Termite Treatment works of Scientific Information Division (SID)at BAEC, Paramanu Bhaban, HQ, Agargaon, Dhaka
- Supply, Installation, testing & commissioning of split Type Air Conditioners at Paramanu Bhaban, HQ,Agargaon, Dhaka
- Renovation works at 2nd Floor corridors at BAEC, Paramanu Bhaban, HQ, Agargaon, Dhaka
- Refilling, testing, fitting, fixing and related works of various type fire extinguishers at BAEC, Paramanu Bhaban, HQ, Agargaon, Dhaka
- Renovation/repair and maintenance works of Chairman, Member, Bio-Science, Member Engineering and Room no-211 HQ at BAEC, Paraman Bhaban, HQ, Agargaon, Dhaka

2.2 At BAEC Housing Colony, Banani

- Renovation/repair and maintenance works of Flat No: Anex-4 & SQ-4, BAEC Housing colony
- Renovation and maintenance works Guest House and related other works at BAEC, Housing Colony, Banani
- Repair and Maintenance Works of Flat No: C-13, 16, 17& D-7 at BAEC housing colony, Banani
- Taking out existing Damage sewerage pipe, sewerage pit, pit cover etc. as per actual requirement with related works and renovation/repair and maintenance works of D-10 with other related works at BAEC housing colony, Dhaka
- Renovation/ Repair and Maintenance works of Flat No C-4, HB-1, 3 At Banani Colony
- Renovation/Repair and Maintenance works of Flat No D-14, 16 at BAEC, Banani colony
- Renovation/repair and maintenance works of Flat No: C-13 at BAEC, Housing Colony

2.3 Under RNPP Project

- Execution of the works for Event Management Including Networking broadband and other related works on 14/7/2018 opening ceremony honorable prime minister for second concrete pouring ceremony in RNPP
- Supply Goods and related works 14/7/2018 for ceremony by the honorable prime minister for second concrete pouring at RNPP [Lot-2]

2.4 At NINMAS & INMAS(s)

- Vertical Extension Works (3rd Floor and other related works) of INMAS, Barisal at Barisal
- Renovation/Repair and Maintenance works of Isolated Patient BED [Therapy Bed] at INMAS, Cumilla

3 Service Rendard

- 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 Sanitation works (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
- Performed Planning & designing services (civil, electrical, mechanical and sanitary) contributed to various facilities at Bangladesh Atomic Energy Regulatory Authority (BAERA)
- Performed Planning & designing services (civil, electrical, mechanical and sanitary) contributed to various facilities of Dhaka, Shylhet, Rajshahi, Chattogram, Dinajpur, Rangpur, Khulna INMAS
- Providing technical expert services in various Centers/institutes/different projects of BAEC and other National Projects outside BAEC like, Department of Environment, Science Museum, Bangladesh Krishi Unnayan Bank and Hi-Tech park

4 Manpower Development and Training Program

Title of the event	Date	Place	No. of participant
Best Practice of Office manner	31/01/2019	Alpha Hall, BAEC, HQ	23
Basic Architectural Planning	03/02/2019	Room No 206, BAEC, HQ	17
Auto CAD (Module-1)	04/02/2019	Room No 206, BAEC, HQ	15
Auto CAD (Module -2)	05/02/2019	Room No 206, BAEC, HQ	13
Auto CAD (Module -3)	06/02/2019	Room No 206, BAEC, HQ	12
Auto CAD (Module -4)	07/02/2019	Room No 206, BAEC, HQ	12
Government Officer's/Staff's Characteristics (Module -1-3)	27/02/2019	Alpha Hall, BAEC, HQ	19
Government Officer's/Staff's Characteristics (Module -4)	27/02/2019	Alpha Hall, BAEC, HQ	6
Basic Building Equipment(Mechanical, Lift, Shower, Module -1)	16/04/2019	Room No 206, BAEC, HQ	16
Basic Building Equipment(Mechanical, AC, Module 2)	17/04/2019	Room No 206, BAEC, HQ	16
Basic Building Equipment(Auditorium, Module -3)	18/04/2019	Room No 206, BAEC, HQ	16
Basic Building Equipment(Mechanical, Module -1)	21/04/2019	Alpha Hall, BAEC, HQ	18
Basic Knowledge of DPP procurement.	23/04/2019	Alpha Hall, BAEC, HQ	18
e-mail and Social media uses (Module -1)	25/04/2019	Alpha Hall, BAEC, HQ	19
Fire Safety, security and prevent hazard.	28/04/2019	Alpha Hall, BAEC, HQ	22
MS Word (Module -1)	07/05/2019	Alpha Hall, BAEC, HQ	23
MS Excel (Module -1)	08/05/2019	Alpha Hall, BAEC, HQ	22
MS Power Point (Module -1)	09/05/2019	Alpha Hall, BAEC, HQ	23
Right to Information Act (Module -1)	13/05/2019	Alpha Hall, BAEC, HQ	17
Basic Electrical Design (Module -1)	20/05/2019	Alpha Hall, BAEC, HQ	23
Engine Auto Mobile vehicle and transport uses (Module -3)	21/05/2019	Alpha Hall, BAEC, HQ	24
Construction Material Measurement	16/06/2019	Alpha Hall, BAEC, HQ	23
Basic ICT equipment (Module -1)	17/06/2019	Alpha Hall, BAEC, HQ	24
Basic ICT equipment (Module -2)	24/06/2019	Alpha Hall, BAEC, HQ	24

5. Seminar/Symposium/Conference/Workshop/Training/Meeting Attended

Name of the Participant	Title of the event	Organizer	Date	Place
Engr. Nasir Ahmed	"Advancing the Understanding of water cycle Process"	IAEA	24 May, 2019	Austria Vieana
Ar. M. R. Parveen	"Infrastructure for NDT "	IAEA	10-14 Jun. 2018	Christchurch Newzeland
Engr.A. Helal, Engr. M. S. H. Chowdhury, Engr.M. Monirruzzaman	"Basic Nuclear Orientation Course(BNOC)-2018"	TI	03 Sept. -02 Nov. 2018	AERE, Savar
Engr. M. Helal	"e -Governance and ICT infrastructure for implementation of Digital Bangladesh"	BIM	05-09 Aug. 2018	Azimpur Dhaka
Ar. M. R. Parveen, Engr. R. A. Biswas, Engr. D.	"Radiation protection for radiation workers and RCO's of BAEC medical	TI	05-09 Aug. 2018	AERE, Savar

Name of the Participant	Title of the event	Organizer	Date	Place
Saha, Engr. A. Islam	facilities & industries "			
Engr. A. Sarder	"Online Office Management(10th batch)"	BIM	16-27 Sept. 2018	Azimpur Dhaka
Engr. R. A. Biswas, Engr. A. Islam	"Applied Statistics using Strata and SPSS"	ISRT, Dhaka University	16 Oct. - 17Nov. 2018	DU
Ar. M. R. Parveen, Engr. M. Rahman, Engr. M. S. H. Chowdhury, Engr. M.Monirruzzaman	"Environmental Radioactivity Monitoring"	TI	13-17Jan. 2019	AERE, Savar
Engr. A. Helal, Engr. M. Billah	"Project Management: Computer Based Approach"	DCE,BUET	22-26 Feb. 2019	BUET Dhaka
Engr. N. Ahmed	"National Conference on physics"	Bangladesh Physical Society	07-09 Feb. 2019	DU
	"7th International conference on Water and Flood Management"	Institute of Water and Flood Management, BUET	02-04 Mar. 2019	BUET, Dhaka
Engr. R. A. Biswas. Engr. M. Billah	"Electronic Government Procurement (e-GP) system"	TI	31Mar. – 04 Apr. 2019	AERE, Savar
Engr. R. A. Biswas	"Reactor Engineering course "	TI	31 Mar. -04 Apr. 2019	AERE, Savar
Ar. M. R. Parveen	"Achieving Sustainable Development Goal(SDGs) in Bangladesh"	BPATC	09-15 Dec. 2018	Savar, Dhaka

6. Preparation of Development Project Pro-forma (DPP)

- "Establishment of Calibration and Quality Control Facilities for Radiotherapy, Diagnostic Radiology and Neutron"
- "Establishment of Cyclotron & PET-CT at Institute of Nuclear Medicine & Allied Sciences (INMAS) Mymensingh & Chattogram 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

Engineering and General Service Division provides engineering and technical services to research and development activities in the Atomic Energy Centre, Dhaka (AECD). This division has six sections: Electrical, Refrigeration & Air Conditioning System, Plumbing, Workshop, Glass Blowing, Utility & Civil Engineering section to support divisional activities. This division also provides all utility related service such as electricity, water supply, ventilation, air-conditioning system, civil works etc. through the respective sections. There are 115 jobs requisition received from different division of AECD, RNPP, BAEC HQ and AERE.

Activities

Repaip Maintinance and Installation Work(s)

Electrical Section

This section has completed 47 jobs. This section also has done major 29 jobs for Administration, store and procurement branch. A few are –

- Repair electricity line several times in Directors room, Accounts and library section
- Repair and set door lock, window curtain ring adjusted in library section
- Tube lights were replacement in various lab rooms, corridors and Director's room
- Entire boundary wall and drivers' room
- Repair and replace tube lights in Officers sitting part in canteen
- Electrical section has done major 12 jobs for Chemistry Division
- Light repair in ACL, Trace Analysis Lab
- Blender machine repair in ACL lab
- Replacement of combined switch in XRF laboratory
- Two fan repair in ACL lab
- Repair, maintenance and replacement of light, fan repair and combined switch socket was used for Health Physics Division (HPD)
- Light and exhaust fan repair in NDT division
- Combined switch and tube lights replace in Electronics Division (ED)
- Electrical maintenance work done in Medical Physics and AFD lab
- Two electrical maintenance work done in Plasma Physics division

Refrigeration and Air-Conditioning System Section

This section has completed 39 jobs. Installed, repaired and maintenance many Air-conditioners of AECD as well as BAEC head quarter building. A few are mentioned below-

- Total three AC were repaired in the TLD room, Main Lab and Divisional Head room in Health Physics Division (HPD)
- Total thirteen AC were repaired (i.e. gas charge, circuit, compressor, blower etc) for all Labs in the Chemistry Division
- Total fourteen AC were repaired in the Administration, Accounts, store and library section
- Total two AC were repaired in the NDT Division
- Two AC were repaired in the Solar Physics Division (SPD)
- Three AC were repaired in the Materials Science Division (MSD)
- Two AC were repaired in the Electronics Division (ED)

Plumbing Section

- Basin and water supply line repaired, toilet flash and low down repaired, Door lock repaired, Water purifier plant repaired in Chemistry Division
- Door lock repaired, window repaired, window glass repaired for sitting room in Administration Division
- Basin and water line repaired in Health Physics Division
- Bathroom sink repaired for Electronics Division were performed
- Repaired the low down and pan commode for gent's toilet
- Repaired the toilet flash for Analytical Chemistry Laboratory
- Repair and maintenance gas line and knob were performed for Atmospheric and Environmental Lab in Chemistry Division
- A strong concrete basement made for drinking water tank under EGS supervision

Workshop Section

This section performed 4 jobs requisition and completed all the works successfully. A few are -

- Metal display board preparation for Administration
- Made machine support stand for Electronics Division
- Made and adjust hardware for Chemistry Division
- Made a nameplate hole for Materials Science Division

Glass Blowing Section

This section has performed two glass related work for chemistry division and BUET for MS research student.

CENTRAL ENGINEERING FACILITIES (CEF), AERE

Introduction

CEF mainly works in construction of infrastructures and installation, repair & maintenance of the necessary equipments as well as providing the services within Atomic Energy Research Establishment (AERE).

The fundamental works of CEF are to help all the institutions of AERE to carry out various sorts of R&D works by providing essential technical supports. It has been taking care of the engineering facilities within AERE campus as per requirements. CEF takes the responsibility of formulating all engineering related jobs e.g. designing, planning, installation, operation and maintenance of all facilities of AERE, the largest research complex of Bangladesh Atomic Energy Commission (BAEC). Power supply system, gas system, water supply system, 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/Program(s)

1. Repair & Maintenance and Renovation Works

- Repaired colony side 25 HP centrifugal pump 3A & 3B
- Supplied drinking water which is used in different laboratories to the area of the office and residential area regularly
- Repaired office side 25 HP centrifugal pump 2B
- Repaired office side 25 HP centrifugal pump 3A
- Repaired & maintained underground water pipeline in AERE
- Painted fan, gates and other equipments in AERE office & residential area
- Operated & maintained deep-well turbine pump & other pumps regularly
- General servicing around 30 Nos. of window & split type A/C in all institutes of AERE
- Around 15 Nos. of refrigerator & fridge have been repaired in different institutes at AERE
- Replaced around 15 Nos. of compressor of fridges, window & split type A/C in different Institutes of AERE.
- Repaired 30 Nos. of window & split type AC at INST, IFRB, TI, IE, ICS, VIP guest house, TAD, Cafeteria, NMU & CAD building
- Repaired 8 Nos. of fridges at INST, IFRB, NMU & TBBRU
- Replaced the seat valves of office side pump 2A and colony side pump 3A, 3C & 3D
- Replaced the motor of colony side pump 3B
- Replaced the motor bearing of colony side pump 3A
- Adjusted the alignment of office side pump 2B
- Replaced around 10 Nos. of blowers of window & split type A/C in all institutes of AERE
- Repaired other refrigeration systems (Cooling incubator, Dehumidifier etc.)
- Operated & maintained the central A/C of INST auditorium

- Supply, Installation & modification of underground water pipe line for AERE Mosque at AERE, Savar, Dhaka
- Supply, installation & modification of underground water pipe line for F-2 & F-3 building at AERE, Savar, Dhaka
- Overhauling, Repairing, Servicing, Testing and Commissioning of 133 ton once Thru' Air Conditioning, Ventilation and Exhaust System at RIPD, INST, AERE, Savar, Dhaka
- Supply of Spare Parts, Consumable Materials, Servicing Works and Repair of Split & Window Type Air-Cooler and Refrigerator for Different Institute at AERE, Savar, Dhaka
- Supply and Refilling of Fire Extinguisher at AERE, Savar, Dhaka
- .Transformer Oil Centrifuging, Generator rent cost, Supplying Transformer Oil, Silica gel, Oil Testing and other related works at CEF, IFRB, HPRWMU-INST and TI Sub-Station, AERE, Savar, Dhaka
- Repairing, Painting & Maintenance work for VIP Guest House, Central Cafetaria, Street Light and Different Institute at AERE, Savar, Dhaka
- Street Light (AERE Clinic to DG Banglo) and Sag Correction of Over Head Line (AERE Clinic to Staff Hostel) at AERE, Savar, Dhaka
- Supply of Electrical goods in CRR, HPRWMU, TAF, IRPT, ICS, INST, IFRB, TI & AERE Colony at AERe, Savar, Dhaka
- Repair of Generator at TI, AERe, Savar, Dhaka
- Supply for Plumbing, Electrical and Workshop Items at CEF, AERE, Savar, Dhaka
- Repair and Maintenance Work of CEF Old Building with Necessary Modification (Phase-1) at AERE, Savar, Dhaka
- Construction of Connecting Road (200rft) Over the Cannel infornt of Pump Gate at AERE, Savar, Dhaka
- Repair and Maintenance work of quarter No. C-3/5, D-1/3, D-1/7, D-1/8, D-2/2, E-1/3, E-1/4, E-1/14, E-2/11, E-3/4, E-3/13, E-4/9, F-1/1, F-1/4, and F-2/4, at AERE, Savar, Dhaka
- Supplying Materials of Cot (13 Nos.) at Ansar Camp, AERE, Savar, Dhaka
- Supply, fitting of Door at INST (Room #113), IE (Room # 204) & 1st Floor Officer Toilet), ICS (Main Gate & 2nd Floor Toilet) and Residential Colony (Quarter # C-2/4, E-2/10 & E-4/12) with Necessary Fittings at AERE, Savar, Dhaka
- Construction of Shade on AC Unit of Kit Facilities and Repair Maintenance of Room no-178, 179, 158, 160, 166, 168 & Entrance Corridor and Electrical Works of RIPD, at INST, AERE, Savar, Dhaka
- Repair and Maintenance of Different Installation of AERE, Savar, Dhaka
- Construction of Bituminus Carpeting Road from Colony Gate (Dhaka-Kaliakoir road) to CEF Gate with Palisading, One Box Culvert & RCC Pipe at Colony Road, AERE, Savar, Dhaka
- Construction of Connecting Road from Guest House South Side to DG's Banglo ar AERE, Savar, Dhaka
- Repairing of School Gate and adjust Boundary wall, Road (65 rft) & Guard Room at AERE, Savar, Dhaka
- Repairing & Maintenance Work of CRR at AERE, Savar, Dhaka
- Repair and Maintenance works at AERE, Savar, Dhaka
- Construction of Dustbin & Connecting Road at Colony Area, AERE, Saver, Dhaka
- Supply Installation and Testing of Computer CPU, Printer, Scanner, and Pendrive at CEF, AERE, Savar, Dhaka
- Repair & maintenance Work of Server Room of ICS at AERE, Savar, Dhaka

IV. INTERNATIONAL AFFAIRS DIVISION (IAD), HQ

Introduction

International Affairs Division (IAD), Bangladesh Atomic Energy Commission (BAEC), has been maintaining assigned liaisons regularly with the international organizations and foreign countries since its inception. The liaisons are bordered normally to the nuclear technology transfer, enrichment of nuclear instrumentation, establishing nuclear power plants and development of human resources for the peaceful application of nuclear science & technology in the country. Under the supervision of BAEC, IAD directly communicates with international organisations to get international projects and simultaneously monitors the progress of the implementing projects.To strengthen the overall nuclear capability of the country, this division makes liaison for foreign trainings, fellowships and scientific visits for scientists, engineers, doctors, geologists, technicians and administration personnels. In the financial year 2018-2019, IAD has processed nominations of 430 participants for various international programme in different countries (except India & Russia). IAD also works to arrange expert missions, international meetings, workshops, seminars, trainings, etc. in BAEC as well as in the country. To enhance R&D (Research and Development) works, IAD plays an important role to execute bilateral and multilateral agreement with foreign countries. Moreover, to fulfill the international obligations related to nuclear safeguards and non-proliferation of nuclear weapons, IAD has also been in constant communication with the International Atomic Energy Agency (IAEA), United Nations Organization (UNO), etc. since the inception of BAEC. A brief description of the activities of IAD during the period of "July, 2018 – June, 2019" is presented below:

1. Activities

1. 1 Technology Transfer

BAEC has been receiving technical assistances mainly from IAEA through Technical Cooperation (TC) Projects, Regional Cooperation Agreement (RCA) and Regional Cooperation Non-Agreement (Non-RCA) Projects, Coordinated Research Projects (CRP) and other special projects of IAEA. As the assigned liaison point of IAEA, IAD is liable to monitor the progresses and outputs of these projects, the reports and to submit the reports to the IAEA, to arrange expert visits, scientific visits, trainings and fellowships for the scientists involved with these projects. IAD also helps the project counterparts to organize training courses, seminars, meetings, etc. in the country.

1.2 Technical Cooperation (TC) projects

In the financial year 2018-2019, IAD worked for Six (6) 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.

1.3 Regional Cooperative Agreement (RCA) Projects

RCA is an intergovernmental agreement among IAEA member states of East Asia and Pacific region. The projects among the twenty two countries of this region are commonly known as RCA Projects. Such projects are involved in research, development and training activities in the related fields of nuclear science and technology through sharing of regional resources including facilities, equipment and expertise as well as exchange of knowledge. IAD performed liaison for Thirteen (13) RCA projects covering different nuclear fields namely- Agriculture, Human Health, Industry, Environmental Protection and Water Resources.

1.4 Non- RCA Projects

These projects are Asia Region Based projects supported by IAEA Technical Cooperation (TC). In these projects, countries from Middle East are also involved with the twenty two RCA countries. In the reported year, IAD made liaison for Thirty Seven (37) Non-RCA projects covering Nuclear power planning, Sustainability of Nuclear Institute, Nuclear Capacity Enhancement, Strengthening Radioactive Waste Management and Radioactive Exposure Control, Irradiation, Physical Protection, Strengthening Health Support, etc.

1.5 Coordinated Research Projects (CRPs)

Bangladesh avails IAEA research supports through the Coordinated Research Projects (CRPs) too. Such research activities are normally conducted by the research institutes of both the developing and developed

countries those are member of IAEA on the same research area of interest. IAEA funds a portion of the project's cost, IAD liaisons for a number of Sixteen (16) CRP projects covering the research area of Food and Agriculture, Human Health, Physical and Chemical Sciences, Nuclear Installation Safety, Nuclear Fuel Cycle, Nuclear Security Culture and Waste Technology Besides BAEC, scientific institutes and Universities of Bangladesh such as ICDDR'B, Dhaka University, Bangladesh Agricultural University (BAU), Radiation Oncology Department of the Hospitals Centre for Woman and Child Health, are involved with CRP's.

2. Projects of the Forum for Nuclear Cooperation in Asia (FNCA)

IAD is the focal point to implement the FNCA projects. The framework of this forum specified to various vital nuclear fields such as: utilization of research reactors, utilization of radioisotopes in agriculture, application of radioisotopes and radiation for medical use, public information of nuclear energy and radiation safety and radioactive waste management, safety culture of nuclear energy, human resources development. The present members of this forum are Japan, Mongolia, Kazakistan, Australia, Bangladesh, China, Indonesia, Republic of Korea, Malaysia, Philippines, Thailand and Viet Nam. In the financial year 2018-2019, IAD made liaison for a number of Seven (7) FNCA projects. In total 8 participants participated in various international programme in the said financial year.

3. Exchange of Experience and Expertise

Exchange Programs under the Ministry of Education, Culture, Sports, Science and Technology (MEXT) and Nuclear Safety Research Association (NSRA) of Japan invite nuclear researchers from neighboring Asian countries to Japan and dispatches Japanese experts to other countries. As the focal point of this program, IAD processed the necessities in favor of the selected scientists, engineers, doctors and technicians of BAEC. Both of these exchange programs or 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.

4. Follow-up Training Courses (FTCs) and Instructor Training Courses (ITCS)

During the reported period, three Follow-up Training Courses (FTCs) are conducted in Dhaka with the help of Japanese and Bangladeshi experts. Through the FTCs Fifty Nine (59) participants are trained in different areas of nuclear science and technology. In addition Six (06) participants for Instructor Training Course (ITC), One (01) participant for Nuclear Plant safety Course; One (1) participant for Nuclear Energy Official Course; one (01) participant for Site Preparation Public Relation Course; one (01) participant for Basic Radiation knowledge for School Education Course have completed the courses. These courses are successfully conducted in Japan.

5. Service Training

In case of the appropriate set up/operation of procured new nuclear instruments specially, under ADP Projects, IAD works to complete the service training processes in order to avail them in the instrument manufactures.

6. Database of Foreign Vsitors

From July 2008, IAD has been maintaining database for the foreign visits of employees of BAEC. This includes various conferences, meetings, trainings, workshops organized by TC, RCA, Non-RCA, FNCA, ANSN etc. Officials from BAEC, MoST and other organizations have attended conferences, meetings, workshops and have availed significant number of fellowships and trainings in the reported period under TC, RCA and FNCA projects.

V. NUCLEAR POWER AND ENERGY DIVISION (NPED), HQ

Introduction

Nuclear Power and Energy Division is running one of the most vital fast track projects of Government of Bangladesh named "Construction of Rooppur Nuclear Power Plant (RNPP) Project". The RNPP project is mainly getting implemented trough Construction and Erection Works, Long Term Manufacturing Equipment, Working Documentation, Supply of General Equipment, Training, Commissioning works/Documents. Along with the "Construction of Rooppur Nuclear Power Plant (RNPP) Project", another important project titled

"Potential Placement of Nuclear Power Plant in South of Bangladesh" is currently ongoing. In order to coordinate and implement these two (2) very important projects of Bangladesh Atomic Energy Commission, Nuclear Power and Energy Division maintains liaison among BAEC, Ministries of Govt. of Bangladesh, International Atomic Energy Agency and Vendor Countries.

1. Activities

The Honorable Prime Minister inaugurated the ceremony of First Concrete Pouring (FCD) of the 2nd Unit of Rooppur Nuclear Power Plant Project on the last 14th July 2018. In that ceremony, the Russian Honorable Deputy Minister Mr. Yuri Borisov was present.

A bilateral meeting of the acceptance inspection under the Long Term Manufacturing Equipment (LTME) of Rooppur Nuclear Power Plant and core catcher installation ceremony, was convened by the honorable Minister of Science and Technology from 17th to 18th August 2018 in Rooppur, Pabna with the presence of the representatives of BAEC, BAERA, ZAES and JSC ASE.

The construction activities outside the nuclear industrial area and most of the land development activities of the Erection Base – 2 area in the project area have been completed in light of the design documentation of the Rooppur Nuclear Power Plant. The work of the vertical leveling in different section of the industrial base is in progress.

In light of the design documentation of Rooppur Nuclear Power Plant, safety documentation according to the licensing conditions imposed by Bangladesh Atomic Energy Regulatory Authority, 4,457,000.00 m^3 volume of soil has been converted to soft rock by deep soil mixing technique in order to strengthen the soil bearing capacity of the total of 167 buildings which are being built in the nuclear island as well as in the project area permanently.

The work for different buildings of Rooppur Nuclear Power Plant is going on. In the mean time 50% work of the total work of the reactor building, turbine building, dematerialized plant, normal operation power supply building and auxiliary power supply building of the 1st Unit, has been completed. In the same way, 50% work of the total work of the reactor building, turbine building, dematerialized plant, normal operation power supply building, auxiliary power supply building of the 2nd Unit and important common facilities have also been completed.

According to the signed General Contract, the supplies of the working documentation to Bangladesh Atomic Energy Commission in every four quarter of the year. According to the project schedule, necessary document was supplied in 14 packages in the year 2018. According to the project schedule of the year 2019, 3 packages of documentation has already been submitted by the Contractor.

In the scope of the General Contract, to construct the Rooppur Nuclear Power Plant, the work on manufacturing necessary equipments is going on in different manufacturing companies appointed by JSC ASE. In this respect, necessary number of signing of readiness protocol, approval of quality plan and closing of control point has been done and the inspection activities on behalf of the Customer is going on. The full scale and analytical simulator is note worthy among Long Term Manufacturing Equipment (LTME) for the Rooppur Nuclear Power Plant Project.

The construction of relevant facilities of Rooppur Nuclear Power Plant Project has progressed significantly. 33% of the work of the construction of Green City living facility has been completed, 33% of the work is on-going and 33% of the work shall be commenced soon. In the same time, the construction of jetty/ cargo terminal and the work on river training are going on.

About 75% of Physical Protection System of Rooppur Nuclear Power Plant Project has been completed.

Under the project title "Survey for the probable site for the Nuclear Power Plant in the Sothern area of Bangladesh", in order to collect existing data-information and analysis of seismological, hydrological, meteorological survey and other man induced events of the 14 primarily probable sites identified by BAEC previously, Center for Environmental and Geographic Information Services (CEGIS) has been given the work-order on last 20th January 2019. Under this work-order, CEGIS has submitted three reports (inception report, draft report & final report) to Bangladesh Atomic Energy Commission. 6 sites are chosen out of 14 sites through ranking them by analyzing different parameters in the final report provided by CEGIS. Presently, the commencement of activities of detail study/ site characterization of these 6 sites is in progress.

Besides, the Draft National Nuclear and Radiological Emergency Preparedness and Response Plan has been ready to send to Ministry of Science and Technology for finalizing the plan after taking care of experts' comments/ suggestions. Also Bangladesh Nuclear Power Communication Strategy (2015 – 2021) has been signed in cooperation of Russian Federation in order to develop nuclear infrastructure to enhance the public acceptance in favor of nuclear energy in Bangladesh.

2. Manpower Development and Training Program

Title of the event	Date	Place	No of participants
Beginners Training Course for Rooppur NPP project Personnel	2-4 Oct. 18	Site Office, Rooppur	25
Beginners Training Course for Rooppur NPP project Personnel	3-6 Dec. 18	Site Office, Rooppur	19
Beginners Training Course for Rooppur NPP project Personnel	25-28 Mar. 19	Site Office, Rooppur	117
Beginners Training Course for Rooppur NPP project Personnel	15-18 Apr. 19	Site Office, Rooppur	26

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

Name of the participant	Title of the Event	Organizer	Date	Place
Dr, M. S. Akber	Inspection of Readiness of the Manufacturing of LTME for the Construction of RNPP Project and the meeting for finalizing the Milestone on Equipment of RNPP	RNPP Project	27 Aug. - 03 Sept. 2018	Moscow, Russian Federation
	47th RCA General Conference Meeting (RCA-GCM) and 62nd IAEA General Conference	IAEA	14 Sept. 2018 and 17-21 Sept. 2018	Vienna, Austria
Dr. Z. Hassan	Inspection of Readiness of the Manufacturing of LTME for the Construction of RNPP Project	RNPP Project	09 - 31 Jul. 2018	Moscow, Russian Federation
	Inspection and Scheduling of Working Documentation (WD) for the Construction of Rooppur Nuclear Power Plant	RNPP Project	11-16 Feb. 2019	Moscow, Russian Federation
M. H. Rahman	62nd IAEA General Conference	IAEA	17-21 Sept. 2018	Vienna, Austria
Engr. M. Hossain	Inspection of Readiness of the Manufacturing of LTME for the Construction of RNPP Project	RNPP Project	09-13 Jul. 2018	Moscow, Russian Federation
Dr. M. Khalaquzzaman	KINS-AEA Workshop on Safety Review and Inspection Methodologies for Quality Assurance	KINS	13-17 May 2019	Daejeon, Korea
Dr. Engr. M. A. Razzaque, F. Islam, S. Sardar, M. Aliuzzaman	Scientific Visit on Waste Management	IAEA and Russian Federation	03-7 Dec. 2018	St. Petersburg, Russian Federation
Dr. M. K. Hossain	IAEA TC Project Scientific Visit to Training Centre for Methodical Materials of Referance Plant	IAEA	1-5 Jul. 2018	Novovoronezh, Russian Federation
M. A. Islam	Inspection and Scheduling of Working Documentation (WD) for the Construction of Rooppur Nuclear Power Plant	RNPP Project	11-16 Feb. 2019	Moscow, Russian Federation
A. Chakraborty	Joint Training Advisory Commission (JTAC) Meeting	RNPP Project	30 Jan. – 09 Feb. 2019	Moscow, Russian Federation

Name of the participant	Title of the Event	Organizer	Date	Place
F. Islam	Training Course on Licensing Process for Nuclear Power Plants	IAEA	23-27 Jul. 2018	Moscow, Russian Federation
	Workshop on Nuclear Power Plant Constructions Oversight by the Bangladesh Atomic Energy Regulatory Authority	IAEA-BAERA	25-28 Feb. 2019	BAERA, Dhaka
	IAEA-KINS Workshop on Safety Review and Assessment for Licensing Nuclear Power Plants	IAEA-KINS, Korea	27- 31 May 2019	Daejeon, Korea
S. Sardar	Joint Training Advisory Commission (JTAC) Meeting	RNPP Project	30 Jan. – 09 Feb. 2019	Moscow, Russian Federation
M. G. Mahbub	Nuclear Kids Projects'	ROSATOM	4-7 Jul. and 16-19 Aug. 2018	Moscow, Russian Federation
	Interregional Training Course on Stakeholder Involvement in Nuclear Power Programmes	IAEA	13 – 17 May 2019	St. Petersburg, Russian Federation
M. Aliuzzaman	IAEA ITC on State Systems of Accounting for and Control of Nuclear Material for Newcomer Countries	IAEA and Republic of Korea	9-20 Apr. 2018	Republic of Korea
	Workshop on BAERA-IAEA Workshop on Technical Safety Review (TSR) Design Safety (DS) for selected sub-chapters of the Preliminary Safety Analysis Report (PSAR) of Rooppur Nuclear Power Plant under the IAEA TC project BGD2015	BAERA and IAEA	24-26 Apr. 2018	BAERA, Authority Building, Agargaon, Sher-e-Bangla Nagar, Dhaka 1207
	Technical Visit to ISCN	ISCN, JAEA	27 - 30 May 2019	Tokai, Ibaraki, Japan
Asma Begum	TC Fellowship on public communication and stakeholder involvement in the development of the nuclear power programme	IAEA	17 Jun. - 19 Jul. 2019	Obninsk, Russian Federation
S. Alam	Inspection of Manufacturing of LTME for the construction of RNPP in Manufacturing plants of Saint Petersburg, Russia	RNPP Project	23 Sept. - 22 Dec. 2018.	Saint Petersburg, Russian Federation
Dr. R. Goswami	Inspection of Readiness of the Manufacturing of LTME for the Construction of RNPP Project	RNPP Project	09-13 Jul. 2018	Moscow, Russian Federation
S. Karmaker	Inspection and Scheduling of Working Documentation (WD) for the Construction of Rooppur Nuclear Power Plant	RNPP Project	13-16 Feb. 2019	Moscow, Russian Federation
R. Siddique	Scientific Visit on Waste Management	IAEA and Russian Federation	03-07 Dec. 2018	St. Petersburg, Russian Federation
	Inspection and Scheduling of Working Documentation (WD) for the Construction of Rooppur Nuclear Power Plant	RNPP Project	13-16 Feb. 2019	Moscow, Russian Federation

Name of the participant	Title of the Event	Organizer	Date	Place
	Workshop on Nuclear Power Plant Constructions Oversight by the Bangladesh Atomic Energy Regulatory Authority	IAEA-BAERA	25-28 Feb. 2019	BAERA, Dhaka
M. A. Huq	Nuclear Energy Management School for Young Professional	Russia - IAEA	03-14 Sept. 2019	St. Petersburg, Russian Federation.
	Inspection of LTME for Rooppur NPP project	BAEC	08 Janu. -09 Apr. 2019	St. Petersburg, Russian Federation
N. R. Kundu	14th Joint ICTP-IAEA School on Nuclear Knowledge Management.	ICTP-IAEA	30 Jul. -03 Aug. 2018	Trieste, Italy
	Joint ICTP-IAEA 2019 International School on Nuclear Security	ICTP-IAEA	25 Mar.-5 Apr. 2019	Trieste, Italy
	WNU Summer Institute 2019	WNU-IAEA	23 Jun. and 27 Jul. 2019	Bucharest, Romania and Baden, Switzerland
A. N. Ehteshamul	Inspection of Readiness of the Manufacturing of LTME for the Construction of RNPP Project and the meeting for finalizing the Milestone on Equipment of RNPP	RNPP Project	27 Aug. – 03 Sept. 2018	Moscow, Russian Federation
B. N. Sattar	Nuclear Energy Management	JAIF, IAEA	17 Jul. 2018-02 Aug. 2019	Japan, Fukushima
M. K. Hamid	Inspection of Readiness of the Manufacturing of LTME for the Construction of RNPP Project	RNPP Project	14 – 20 Jul. 2018	Moscow, Russian Federation
S. Z. Tasnim	TC project Group Visit on QM/QA at Construction Stage	IAEA	15-19 Oct. 2018.	St. Petersburg, Russian Federation
M. I. U. I. Chowdhury	Inspection of Readiness of the Manufacturing of LTME for the Construction of RNPP Project	RNPP Project	21 - 31 Jul. 2018	Moscow, Russian Federation
M. R. Haque	Inspection of Readiness of the Manufacturing of LTME for the Construction of RNPP Project	RNPP Project	15 Dec. 2018 – 15 Mar. 2019	Russian Federation
M. R. Amin	Inspection of Readiness of the Manufacturing of LTME for the Construction of RNPP Project	RNPP Project	01 Jan. – 31 Mar. 2019	Russian Federation
S. Ahmed	TC Fellowship on public communication and stakeholder involvement in the development of the nuclear power programme	IAEA	17 Jun. – 19 Jul. 2019	Obninsk, Russian Federation
M. K. Islam	Visit to Generation 3+ Reactor of Novovoronezh Nuclear Power Plant	RNPP Project	15- 19 Jan. 2019	Novovoronezh , Russian Federation

4. Stakeholder Meeting

- A bilateral meeting between JSC ASE and BAEC to review the documentation to achieve M0 milestone of the Training Simulator (Analytical and Full Scope Simulator) of LTME No. 29 & 30 of Rooppur Nuclear Power Plant Unit1 & 2, was held from 4th to 5th July 2018 in Rooppur NPP Bhavan, 4 Kazi Nazrul Islam Avenue, Shahbagh, Dhaka.

- A meeting convened by the Project Director on taking decision of importing Cements sensors from France proposed by JSC ASE and reviewing its relevant technical documentation, was held on 5th July 2018 in Rooppur NPP Bhavan, 4 Kazi Nazrul Islam Avenue, Shahbagh, Dhaka.
- In order to implement the Rooppur Nuclear Power Plant Project properly, a meeting convened by the Chairman of Bangladesh Atomic Energy Commission on banking charge of the advance payment sent to Contractor JSC ASE of Russian Federation through Sonali Bank Limited, was held on 23rd July 2018 in Rooppur NPP Bhavan, 4 Kazi Nazrul Islam Avenue, Shahbagh, Dhaka.
- A meeting convened by the Member Engineering on taking decision of using Roechtest sensors which shall be used in foundation plate of Unit 2, from Canadian Company and reviewing its relevant technical documentation, was held on 8th August 2018 in Rooppur NPP Bhavan, 4 Kazi Nazrul Islam Avenue, Shahbagh, Dhaka.
- A bilateral meeting between BAEC and JSC ASE convened by the Member Engineering on the procedure of achieving M0 milestone and afterwards M1, M2 milestone of LTME Equipment Simulator (As and FSS) for the Rooppur Nuclear Power Plant, was held from 25th to 27th September 2018 in Rooppur NPP Bhavan, 4 Kazi Nazrul Islam Avenue, Shahbagh, Dhaka.
- A bilateral meeting between BAEC and JSC ASE on finalization of the Supplementary Contract for the Rooppur Nuclear Power Plant, was held from 25th to 29th October 2018 in Rooppur NPP Bhavan, 4 Kazi Nazrul Islam Avenue, Shahbagh, Dhaka.
- A bilateral meeting between BAEC and JSC ASE convened by the Member Engineering on review of the documentation for achieving M0 milestone of LTME Equipment Simulator (Analytical and Full Scope Simulator) and taking further steps after signing M0 milestone for the Rooppur Nuclear Power Plant Unit-1 & 2, was held on 29th October 2018 in Rooppur NPP Bhavan, 4 Kazi Nazrul Islam Avenue, Shahbagh, Dhaka.
- A bilateral meeting between BAEC and JSC ASE convened by the Project Director on Appendix 10 table 2 of General Contract for the Rooppur Nuclear Power Plant, was held on last 23rd October 2018 in Rooppur NPP Bhavan, 4 Kazi Nazrul Islam Avenue, Shahbagh, Dhaka.
- A meeting convened by the Chairman of Bangladesh Atomic Energy Commission on disbursing advance payment to the Contractor JSC ASE of Russian Federation through Sonali Bank Limited and credit utilization for the proper implementation of Rooppur Nuclear Power Plant, was held on 7th November 2018 in Rooppur NPP Bhavan, 4 Kazi Nazrul Islam Avenue, Shahbagh, Dhaka.
- A meeting on discussion of expenditure for the year 2018 under the financial contract of the Rooppur Nuclear Power Plant Project and determination of expenditure for the year 2019 was held on 19th December 2018 at 11:00 AM with the presence of Finance Director of Russian Federation, Mr. Anton Kozhinov in Block 15, room number 15, Economic Relation Division, Agargaon.
- A bilateral meeting convened by Member Engineering between representatives of BAEC and Rosatom Overseas (RAOS) to finalize the Nuclear Fuel Supply Contract of Rooppur Nuclear Power Plant, was held from 15th January 2019 in Rooppur NPP Bhavan, 4 Kazi Nazrul Islam Avenue, Shahbagh, Dhaka.
- The 3rd meeting of Technical Expert Group for establishing cyber security system of Rooppur Nuclear Power Plant convened by Professor Dr. Mahbabul Alam Joardar, Information Technology Institute of Dhaka University, was held on 20th January 2019 in Rooppur NPP Bhavan, 4 Kazi Nazrul Islam Avenue, Shahbagh, Dhaka.
- A meeting convened by the Project Director on reviewing the design and working documentation of shore protection and water intake structure for the protection of the bank of Padma situated near Rooppur Nuclear Power Project, was held from 27th to 29th January 2019 in Rooppur NPP Bhavan, 4 Kazi Nazrul Islam Avenue, Shahbagh, Dhaka.
- A meeting convened by Member Engineering among JSC ASE, BTCL and BAEC on discussion of internet and data communication system of Rooppur Nuclear Power Plant Project was held from 4th to 5th January 2019 in Rooppur NPP Bhavan, 4 Kazi Nazrul Islam Avenue, Shahbagh, Dhaka.
- The fourth meeting of the Joint Coordination Committee between Bangladesh and Russian Federation for the implementation of Rooppur Nuclear Power Plant Project was held on 6th march 2019 in Dhaka. In that meeting, the honorable Minister of the Ministry of Science and Technology leaded the Bangladesh team.

- A bilateral meeting between BAEC and the Contractor JSC ASE on determination of payment milestone of year 2019 under the Appendix 10 of the General Contract and the progress of the construction work, was held from 21st to 28th March 2019 in Rooppur NPP Bhavan, 4 Kazi Nazrul Islam Avenue, Shahbagh, Dhaka.
- The 4th meeting of Technical Expert Group for establishing cyber security system of Rooppur Nuclear Power Plant convened by Professor Dr. Mahbabul Alam Joardar, Information Technology Institute of Dhaka University, was held on 14th March 2019 in Rooppur NPP Bhavan, 4 Kazi Nazrul Islam Avenue, Shahbagh, Dhaka.
- A meeting convened by Member Engineering among the representatives of JSC ASE, BPDB, BAEC on ensuring of transmitting generated electricity from Rooppur Nuclear Power Plant, was held on last 10th and 13th March 2019 in Rooppur NPP Bhavan, 4 Kazi Nazrul Islam Avenue, Shahbagh, Dhaka.
- In order to successfully train the manpower of Rooppur Nuclear Power Plant Project, a meeting on the successful implementation of Appendix 14 of General Contract, was held from 9th to 11th April 2019 in Rooppur NPP Bhavan, 4 Kazi Nazrul Islam Avenue, Shahbagh, Dhaka.
- A purchase committee meeting for G to G purchase according to the order no 36 dated 24th January 2016 from the Prime Minister's Office, convened by the Secretary of MOST on providing recommendations of proposed fuel supplied from the company of Russian Federation of Nuclear Fuel Supply Contract under the signed Inter Governmental Agreement (IGA) between Bangladesh and Russian Federation for Rooppur Nuclear Power Plant Project, was held on 14th May 2019 in the Committee room of the Ministry of Science and Technology.
- A bilateral meeting convened by Member Engineering between JSC ASE and BAEC on discussion of design documentation of Rooppur Nuclear Power Plant Project was held from 27th to 30th May 2019 in Rooppur NPP Bhavan, 4 Kazi Nazrul Islam Avenue, Shahbagh, Dhaka.
- A bilateral meeting convened by Member Engineering and the Head of JTAC between JSC ASE and BAEC on the successful & standardized implementation of Appendix 14 of General Contract for the training of manpower of Rooppur Nuclear Power Plant Project was held from 27th to 28th July 2019 in Rooppur NPP Bhavan, 4 Kazi Nazrul Islam Avenue, Shahbagh, Dhaka.

VI. NUCLEAR SAFETY, SECURITY AND SAFEGUARDS DIVISION (NSSSD), HQ

Objective/Introduction

- To fulfill the obligations under International Treaties, Agreements, Protocols and Conventions related to Nuclear Safety and Radiological Emergencies including Safeguards and Physical Protection of nuclear and radioactivematerials having in the BAEC.
- To maintain safeguards procedures of the State Systems of Accounting for and Control of Nuclear Material (SSAC).
- To ensure the physical protection of nuclear material and radioactive sources and associated installations of BAEC.
- Working as the focal point of different well-known strategic partner namely International Atomic Energy Agency (IAEA), U.S. Department of Energy (USDOE), Japan Atomic Energy Agency (JAEA), Forum for Nuclear Cooperation in Asia (FNCA) and emerging Asia-Pacific Safeguards Network (APSN) for the issues of nuclear safeguards, safety, security and physical protection of radioactive materials and associated facilities.

Activities/Program

1. Research and Development Work(s)

'Study on the Economical Growth of Leaf Extract Mediated Silver Nanoparticles and Their Biomedical Application Viability' under the special allocation of Science and Technology Ministry (No. 39.00.0000.009.14.007.19/MEDI'S-18/525, Allocation Tk 5.50 Lac)

2. Manpower Development and Training Program

Title of the event	Date	Place	No. of participants
Site Security Plan Workshop	8-11 April 2019	Hotel The Westin, Dhaka	12

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

Name of the participant	Title of the event	Organizer	Date	Place
Dr. A. Imtiaz	FNCA 2018 Workshop on Nuclear Security and Safeguards	SNSTC & MEXT	11-13 Sept. 2018	China
	International Symposium on Communicating Nuclear and Radiological Emergencies to the Public	IAEA	1-5 Oct. 2018	Austria
	International Conference on the Challenges Faced by Technical and Scientific Support Organizations in Enhancing Nuclear Safety and Security: Ensuring Effective and Sustainable Expertise	IAEA	15-18 Oct. 2018	Belgium
	National Conference on Physics 2019	BPS	7-9 Feb. 2019	Dhaka
	Second Research Coordination Meeting on the Organizational Cultural Basis for Successful Performance in Nuclear Power Plants	IAEA	09-11 Apr. 2019	Austria
Dr. A. K. M. F. Kibria	Bangladesh Chemical Congress 2018	BCS	17-19 Oct. 2018	Dhaka
	9th Annual Meeting of APSN& IAEA Symposium on International Safeguards	APSN	1-3 & 5-8 Nov.. 2018	Austria
	International Conference on the Security of Radioactive Material: The Way Forward for Prevention and Detection	IAEA	3-7 Dec. 2018	Austria
	5th Conference of Bangladesh Crystallographic Association	BCA	25-26 Jan. 2019	Dhaka
	International Conference on Electronics and ICT 2018	BES	25-26 Nov. 2018	Dhaka
H. M. B. Alam	Regional Meeting on Integrated Nuclear Security Support Plans (INSSPs) for States in South and East Asia	IAEA	5-8 Nov. 2018	China
	International Conference on Electronicsand ICT 2018	BES	25-26 Nov. 2018	Dhaka
Dr. A. K. M. F. Kibria, Dr. A. Imtiaz, H. M. B. Alam	Transportation Security for Radioactive Material, Table-Top Exercise	US DOE	13-16 May 2019	USA

4. Collaboration Work(s)

- Bangladesh's Integrated Nuclear Security Support Plan (INSSP) is in force. Since the issue of the Agreement on the Privileges and Immunities of the IAEA is not resolved yet, several programs scheduled to be hosted in Dhaka arestill remained postponed. Administrative procedures are in action to solve this issue.
- This Division has been continuing research on 'Factors that Influence Culture for Safety, Organizational Culture and Human Performance at Nuclear and Other Facilities in Bangladesh' under the IAEA Coordinated Research Project (CRP) 'I22004' entitled 'Organizational Culture Basis for Successful

Performance in Nuclear Power Plants'. A conceptual model of organizational and human factors was developed as they interact with the national cultural dimensions of Bangladesh based upon the work of Hofstede. In order to capture these factors and collect data, survey has been going on to validate the model against the IAEA framework of safety culture.

- Nuclear Security and Safeguards Project under the cooperation activities of FNCA.
- Works have been going on to extend collaboration with the APSN.
- Supervision of security enhancement activities at the nuclear and radiological facilities of AERE and in parallel to the governmental and private hospitals of the country having radiotherapy machines consisting of radioactive sources and concealed radioactive materials therein under the Basic Ordering Contract (BOC) No. 11968-AD8, Rev. 1 between BAEC and Battelle Memorial Institute (BMI) of U.S. Department of Energy.

VII. PLANNING AND DEVELOPMENT DIVISION (PDD), HQ

As a premier research organization of the country, Bangladesh Atomic Energy Commission (BAEC) has been engaged in research and development activities in different disciplines of nuclear science & technology. BAEC contributes socio-economic development of Bangladesh through peaceful application of nuclear energy. In according National science and technology policy BAEC has been undertaking initiatives for upgrading and extension of different laboratories through development projects.

Activities

There are 14 (Fourteen) projects of Bangladesh Atomic Energy Commission (BAEC) were incorporated in the Annual Development Programme (RADP) of 2018-2019.

The total RADP allocation of the year 2018-2019 for implementation of ongoing project of Bangladesh Atomic Energy Commission was Tk. 1151331.00 Lakh. Out of this granted allocation, Tk. 1151331.00 Lakh had been spent up to 30 June, 2019 making an implementation rate of 100% 14 (Fourteen) new projects, in total have been proposed for the FY 2018-2019 from BAEC to the concerned Ministry. The entire picture on the advancement of all the development projects are shown in Table-1.

Table 1: Status of advancement of all the development projects of BAEC under RADP in fiscal year 2018-2019

(Taka in lac)

Sl. No	Name of the Project with Project Implementation Period	Estimated Cost Total (F.E)	Cumulative Expenditure upto, June 2018 (F.E)	Revised Allocation for the year 2018-2019 (F.E)	Expenditure during 1st July, 2018 to 30th June 2019	Percentage of expenditure against allocation upto 30th June 2019	Achievement of the projects
1	2	3	4	5	7	9	10
A)	**On-Going Projects:**						
1.	Establishment of Positron Emission Tomography –Computed Tomography (PET-CT) with Cyclotron facilities.) October 2011 – June 2019.	15074.71 12731.67	13394.00 11543.00	1681.00 1405.00	1680.71 1404.71	100% 100%	On goining (will be completed June 2019.)
2.	Modernization of Food and Radiation Biology Facilities of AERE, Savar April 2016 - December 2019	4984.00 2350.00	2304.84 1381.00	1700.00 934.00	1700.00 934.00	100% 100%	On goining (will be completed December 2019.)
3.	Construction of Rooppur Nuclear Power Plant April 2016 – December 2025	11309291.28 10120000.00	1215828.11 227591.43	1132075.00 179685.00	1132550.13 179685.00	100% 100%	On goining (will be completed December 2025.)
4.	Capacity build-up of nano and nano-biotechnological laboratory at Materials Science Division Atomic Energy Centre Dhaka.	5552.00 4694.00	2490.00 1975.00	3047.00 2719.00	3047.00 2719.00	100% 100%	On goining (will be completed June 2019.)

Sl. No	Name of the Project with Project Implementation Period	Estimated Cost Total (F.E)	Cumulative Expenditure upto, June 2018 (F.E)	Revised Allocation for the year 2018-2019 (F.E)	Expenditure during 1st July, 2018 to 30th June 2019	Percentage of expenditure against allocation upto 30th June 2019	Achievement of the projects
1	2	3	4	5	7	9	10
	October 2016 - June 2019						
5.	Development of Human Resources & Establishment of Residential Accommodation Facilities for the Radiation Testing and Monitoring Laboratory, Mongla April 2017 - June 2020	1825.00 0.00	100.00 0.00	716.00 0.00	716.00 0.00	100% 100%	On goining (will be completed June 2020.)
6.	Enhance Capacity of Institute of Nuclear Medicine and Allied Sciences (INMAS) at Dhaka, Chattogram, Khulna, Sylhet, Rajshahi, Dinajpur and Rangpur. July 2017 - June 2020	21740.00 12172.00	3600.00 3000.00	8000.00 4400.00	8000.00 4400.00	100% 100%	On goining (will be completed June 2020.)
7.	Sitting for Nuclear Power Plant in the Southern Part of Bangladesh July 2017 - June 2019	977.34 0.00	105.67 0.00	150.00 0.00	150.00 0.00	100% 100%	On goining (will be completed June 2019.)
8.	Establishment of Institute of Nuclear Medicine and Allied Sciences (INMAS) at 8 Medical Collage Hospital Campuses in the country. July 2017 - June 2020	58230.00 19520.00	272.00 0.00	2141.00 0.00	2141.00 0.00	100% 100%	On goining (will be completed June 2020.)
9.	Establishment of Calibration and Quality Control Facilities for Radiotherapy, Diagnostic Radiology and Neutron July 2018 - June 2021	4679.15 2810.60	0.00 0.00	789.00 624.00	789.00 624.00	100% 100%	On goining (will be completed June 2021.)
10.	Technical Survery Project for High Power Nuclear Research Reactor in Bangladesh July 2018 - June 2020	715.69 184.33	0.00 0.00	142.00 0.00	142.00 0.00	100% 100%	On goining (will be completed June 2020.)
11.	Establishment of Cyclotron & PET-CT at Institute of Nuclear Medicine & Allied Sciences (INMAS) Mymensingh & Chattogram and Cyclotron facilities at Institute of Nuclear Medical Physics (INMP), Savar. July 2018 - June 2022	67300.00 3237.00	0.00 0.00	213.00 0.00	213.00 0.00	98.44% 98.44%	On goining (will be completed June 2022.)
12.	Improvement and modernization of the laboratory Facilities of Institute of Electronics July 2018 - June 2020	3431.50 2070.00	0.00 0.00	80.00 0.00	79.50 0.00	99.38% 98.44%	On goining (will be completed June 2020.)
13.	Balancing, Modernization, Refurbishment and Extension (BMRE) of Safety Systems of the 3 MW TRIGA Mark-II Research Reactor Facility at AERE, Savar, Dhaka July 2018 - June 2021	7494.84 2120.00	0.00 0.00	134.00 0.00	134.00 0.00	98.44% 99.38%	On goining (will be completed June 2021.)
14.	Screening of Congenital Hypothyroidism in Newborn Babies (Phase-2) July 2018 - June 2021	4770.16 1200.00	0.00 0.00	463.00 175.00	463.00 175.00	100% 100%	On goining (will be completed June 2021.)
	Total :	**11506065.67** **10180969.60**	**1238094.62** **245490.43**	**1151331.00** **189942.00**	**1151805.34** **189941.71**	**100%** **100%**	

Table 2: Status of advancement of all the development (Approved & unapproved) projects of BAEC under ADP

Sl. No	Name of the Project, Approval Status and Implementation Period	Approval Status	Estimated Cost Total (F.E)	Proposed ADP for the year of 2018-2019 (F.E.)	Remarks
(B) Approved New-project					
1.	Establishment of Calibration and Quality Control Facilities for Radiotherapy, Diagnostic Radiology and Neutron July 2018 - June 2021	Approved	4679.15 (2810.60)	789.00 (624.00)	Approved Planning Minister.
2.	Technical Survery Project for High Power Nuclear Research Reactor in Bangladesh July 2018 - June 2020	Approved	715.69 (184.33)	142.00 (0.00)	Approved Planning Minister.
3.	Establishment of Cyclotron & PET-CT at Institute of Nuclear Medicine & Allied Sciences (INMAS) Mymensingh & Chattogram and Cyclotron facilities at Institute of Nuclear Medical Physics (INMP), Savar. July 2018 - June 2022	Approved	67300.00 (3237.00)	213.00 (0.00)	Approved Planning Minister.
4.	Improvement and modernization of the laboratory Facilities of Institute of Electronics July 2018 - June 2020	Approved	3431.50 (2070.00)	80.00 (0.00)	Approved Planning Minister.
5.	Balancing, Modernization, Refurbishment and Extension (BMRE) of Safety Systems of the 3 MW TRIGA Mark-II Research Reactor Facility at AERE, Savar, Dhaka July 2018 - June 2021	Approved	7494.84 (2120.00)	134.00 (0.00)	Approved Planning Minister.
6.	Screening of Congenital Hypothyroidism in Newborn Babies (Phase-2) July 2018 - June 2021	Approved	4770.16 (1200.00)	463.00 (175.00)	Approved Planning Minister.
(C) Proposed New-project					
7	Capacity build up of Bangladesh Atomic Energy Commission for Geological Survey July 2018 - June 2021	Unapproved	17836.00 (4120.00)	0	Weight for approved in planning commission
8	Construction of New Residential Buildings and Infrastructure Development of Existing Residential Area of Bangladesh Atomic Energy Commission July 2018 - June 2022	Unapproved	58686.61 (0)	0	Weight for approved in planning commission

VIII. QUALITY MANAGEMENT DIVISION (QMD), HQ

Introduction

In this fiscal year Quality Management Division (QMD) carried out various quality related tasks like forming Bio-data evaluation committees, designing and printing posters for display, drafting quality procedure, taking initiatives to promote potential research programmes, preparing SDG related reports, performing editorial work regarding Bangla Version of BAEC Service Regulations-1985, helping update Organogram, preparing report on 'Specific Areas of Cooperation between Bangladesh and Republic of Korea' performing duties as some important committees members.

Activities

1. Forming Bio-data Evaluation Committees 1, 2, 3, 4, 5, 6 as per 'Procedure for forming Committees for Evaluating Bio-Data of Officers and Staff (BAEC/SOP-017)'

Prepared the abovementioned Committees as per BAEC/SOP-017

2. Designing and Printing Posters for Display

To create awareness on Quality Culture, Safety, Policy etc. 20 posters were designed and printed. Necessary measures were taken for the display of the posters in the different selected locations of BAEC Head Office.

3. Drafting 'Procedure for Management of Transport System of BAEC Head Office (BAEC/SOP-018)'

Drafted the above mentioned procedure with the following objectives-

On the basis of its institutional regulations every organization should have specific and explicit procedures/guidelines/rules for the management of its transport system. The rules should be applicable to all employees with respect to their status of the posts. BAEC has to spend a substantial amount of money of its annual budget in transport system. So it is important to have a procedure regarding proper management of our transport system. This procedure describes guidelines/rules for the management of the transport system of BAEC.

4. Initiatives for Selection of Potential Research Programmes to Promote them by Providing More Support

As part of implementation of "General Procedure for Programme Approval & Periodic Evaluation (BAEC/SOP-1)" 12 Institutions under Physical Sciences & 2 Other Institutions submitted a total number of 221 programmes. A few programmes were selected as potential ones from those 221 programmes by competent authority. Also took necessary actions to collect details of those potential programmes with a view to presenting the information to the competent authority to promote the programmes.

5. Preparing and Submitting SDG Related Reports

As the focal point regarding SDG, prepared the reports on Information on initiatives taken by BAEC to implement SDG and Information/Data on BAEC's SDG implementation progrss by using reporting template for the national conference on SDG Implementation review.

6. Editorial Work Regarding Bangla Version of BAEC Service Regulations, 1985 for Submition to Competent Authority

7. Update BAEC Organogram for submition to competent authority

8. Collaboration Work

Actively involved in preparing the report on 'Specific Areas of Cooperation between Bangladesh and Republic of Korea'.

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

Name of the participant	Title of the event	Organizer	Date	Place
Dr. M. Q. Huda	RNPP Simulator Verification Inspection	BAEC	15-20 Oct. 2018	Moscow, Russia
	RNPP Simulator Verification Inspection	BAEC	07-14 Dec. 2018	Moscow, Russia
	JTAC Meeting for RNPP Personnel Training	BAEC	30 Jan. -09 Feb. 2019	Moscow, Russia
	Scientific Visit	IAEA	18-27 Feb. 2019	Kyoto University Japan
	JTAC Meeting for RNPP Personnel Training	BAEC	22-31 May 2019	Obninsk and Novovoronezh, Russia
Engr. P. K. Saha	E-Nothi Training Programme	BAEC	16-18 Apr. 2019	BAEC Head Office , Dhaka
Engr. D. Das	Training on "Enhancing Innovation Proficiency"	MOST	06-10 Apr. 2019	BCSIR, DHAKA

10. Other

- Actively involved in the activities of RNPP through different committees.
- Delivered duties as the member of some important committees/team like "Citizen Charter related Committee", "Innovation Team" etc.
- Personnel delivered duties as the members of some other committees.

IX. SCIENTIFIC INFORMATION DIVISION (SID), HQ

Introduction

Scientific Information Division plays the key role to collect, select, process and provide information to a wide range of stakeholders concerned with the R&D activities of BAEC. In addition, SID acts as an liaison between BAEC and the government on one hand and public, press etc on the other hand.

Activities/Task(s)

- Compilation, Editing and Publication of Scientific Journals, Periodicals reports, Annual Reports, Popular scientific articles, Brochure, Proceedings, Souvenir, leaflet, etc. related to R&D works of BAEC.
- Collection, selection, processing for storage and dissemination of information in the field of scientific research and technological development of all branches of sciences with particular emphasis to the nuclear technology research and development.
- Maintaining liaison with the News media, TV, Radio, etc. to disseminate news of scientific programs, symposia, conference, seminar, workshop, training etc. under R&D and service activities of BAEC.
- Updating information/documents in the website.
- Selection, acquisition and distribution of Books, Journals, Magazines, Annual report, Scientific News Letter and other scientific documents.
- Processing nomination of BAEC scientists to attend various National Seminar, Symposium, Conference, Workshop etc.
- Processing nomination of BAEC Scientists for award at home and abroad.
- Preparing reports and providing information for the National Assembly/Ministry of Science and Technology and other relevant government authorities relating to BACE activities.
- Publishing tender/notification/press release of BAEC in the daily newspapers.
- Taking and displaying of photographs in different occasions of BAEC and documentation of printed photographs for further use etc.
- Compilation, Editing and Publication of diary/Telephone index/Guide books, Booklets, Yearly Calendar, etc.
- Collection and upgrade the abstract of published scientific papers in BAEC website www.baec.gov.bd

The Key Responsibilities

Description of work	Quantity	Remarks
BAEC Annual Report 2018- 2019	300	Published, distributed and uploaded to the BAEC website *www.baec.gov.bd*
Arranging/Attending science fair/digital fair	8	Successfully completed
BAEC Diary 2019	1300	Published and distributed
Pocket directory (English & Bangla) 2019	1080	Published and distributed
Tender/Advertisement etc. sent to the newspaper	84	Published in the 110 daily newspapers
Newspaper clipping	312	Successfully completed
Press release on training, workshop etc. conducted by BAEC	6	Published in the daily newspapers
Photographic service (processed, printed and supplied)	20000	Distributed to the relevant divisions,organizations,etc.

Description of work	Quantity	Remarks
Processed nominations of BAEC scientists to attend various scientific/technical/workshop/ seminar etc. arranged locally by different academic/professional institutes	408	Nomination letters were distributed to the relevant particiopants
Provide National Parliamentary questions and answers	2	Successfully completed
Provide Parliamentary Committee Report	1	Successfully completed
Provide BAEC information for Preparation of Ministry Annual Report	2	Successfully completed
Preparation of annual performance agreement 2018-2019 between BAEC & MOST & Different Inst./Centre/Unit with BAEC	33	Successfully completed
Preparing APA reports of BAEC	18	Successfully completed
Providing input for different bilateral contract/MoU/international conference/ meeting	30	Successfully completed
Preparing and providing opinions on the issues, acts, laws, etc.	18	Successfully completed
Preparing and providing monthly report to MOST	12	Successfully completed
Preparing and providing Election manifesto report to MOST	12	Successfully completed
National Integrity Strategy (NIS)	4	Successfully completed
APA Report uploaded to APAMS of Cabinet Division	5	Successfully completed
Printing BAEC Annual Calendar 2019	2500	Successfully completed
Tatha Obmuktokaran Nirdeshiks	300	Successfully completed

X. HUMAN RESOURCES DIVISION (HRD), HQ

Objective/Introduction

The Human Resource Management approach remains integrated to the organization's core strategy and vision. It seeks to optimize the use of human resources for the fulfillment of organizational goals. This strategic and philosophical context of Human Resources Development and Management makes it more purposeful, relevant, and more effective compared to the traditional Establishment approach. With this view, the Human Resources Division (HRD) is launched in BAEC. The HRD Division is working directly under the Chairman and bears the prime responsibility for the enhancement of skills and management of human resources of BAEC.

Activities/Program(s)

1. Research and Development Work(s)

Being a Research Reactor (RR) utilization expert (NAA), the Director HRD is also engaged in R&D activities using the 3 MW TRIGA Mark-II RR.

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

- Worked as a member of IAEA RCA Mid Term Strategy Coordination Group;
- Worked as the Leader of IAEA ANSN Education and Training Topical Group;
- Worked as a IAEA Technical Group of Human Resource Management for Nuclear Energy;
- Worked as the Counter part of the RCA Project entitled "RAS/0/073: Supporting Human Resource Development and Nuclear Technology".
- Gave support to the ADP projects of BAEC for manpower recruitment, project implementation, etc.

- Work with JAEA Steering Committee as a BAEC representative.
- Worked as a member of TC Projects evaluation.

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

Name of the Participant	Title of the event	Organizer	Date	Place
Dr. S. M. Hossain	Regional Meeting to discuss the RCA MTS 2018/2023 and review the RCA Guidelines and Operating Rules	IAEA	30 July – 2 Aug. 2018	Seoul, Republic of Korea.
	TC Consultancy Meeting on IWP for Bangladesh	IAEA	17-20 Dec. 2018	Vienna, Austria.
	5th Meeting of the Working Group on the coordination of the RCA MTS	RCA & IAEA	28-31 Jan. 2019	Vienna Austria.
	The Fukui International Meeting on HR Development for Nuclear Energy in Asia 2019	JAEA	06-08 Feb. 2019	Fukui, Japan.
	Scientific Visit-Technical Study Project to Establish High Power Research Reactor in Bangladesh	ADP	25 April – 03 May 2019	Argentina

4. Others

- Worked as a Member of the Syllabus Formation Committee in M.Sc., Dept. of Nuclear Engineering, University of Dhaka
- Worked as a Senate Member of Jahangir Nagar University in Research Category
- The following 2 lectures were given to the BAEC BNOC Training Course 2018 (1st Batch): Nuclear Physics Part-I, Nuclear Physics Part-II and Nuclear Reactions and their applications;
- 3 lectures were delivered to the NDT Radiographic Testing Level-2 Training Course: i) Penetrating Radiation & Radioactivity; ii) Interaction of radiation with Matter; iii) Radiographic Equipment- Gamma Ray
- Took all sorts of initiatives related to innovation activities and made liaison with the MOST and other organizations as a Innovation Officer of BAEC
- Nomination procedure of Bangladesh Atomic Energy Commission (BAEC) employees to attend various training program conduct by different organizations e.g. BIM, NAPD, RPATC, EIB etc. are being handled by the Human Resources Division of BAEC.
- Give logistic supports to the BAEC related to human resources development, management and other relevant activities under both revenue and projects.

5. BAEC Mitigated Work(s)

বিষয়	সংখ্যা
বিভিন্ন প্রশিক্ষণ কোর্সে কর্মকর্তা/কর্মচারিগণের অংশগ্রহণের লক্ষ্যে মনোনয়নে সহায়তা প্রদান	৬০ টি
বিভিন্ন প্রশিক্ষণ কোর্স ও সভা আয়োজন	৬০ টি
বিভিন্ন দেশী/বিদেশী ফেলোশীপ/প্রকল্পের আওতায় প্রকল্প প্রস্তাব/কারিগরি সহায়তা প্রদান	৬ টি
বিভিন্ন সমঝোতা স্মারক স্বাক্ষর আয়োজন এবং সরকার কর্তৃক প্রনীত বিভিন্ন বিশ্ববিদ্যালয়/প্রতিষ্ঠানের খসড়া আইনের উপর মতামত প্রদান	৪টি
বার্ষিক উদ্ভাবন কর্মপরিকল্পনা প্রস্তুত ও প্রেরণ এবং ইনোভেশন সংক্রান্ত প্রশিক্ষণ আয়োজন	৩ টি
মন্ত্রণালয়ের মাসিক সমন্বয় সভায় গৃহীত সিদ্ধান্তের বাস্তবায়নের অগ্রগতির প্রতিবেদন প্রেরণ	২ টি

XI. SCIENTIFIC INFORMATION UNIT (SIU), AERE

Objectives

The main responsibilities of the Scientific Information Unit (SIU) are to furnish documentation of the scientific achievements attained in different Institutes/Units of the Atomic Energy Research Establishment (AERE) and to collect and preserve scientific documents to be used primarily by the scientists of AERE conducting research and development (R&D) activities in nuclear science and technology. Another important involvement of the Unit is to extend required co-operation and coordination in documenting (both electronic and traditional) seminars/symposiums/workshops etc. held in AERE. In the domain of public relation the Unit gets involved in attending the official delegates both from home and abroad, and visitors and guests of AERE.

Activities/Involvements

- **Publication of AERE Technical Report, vol. 23:** The major documentation activity within the reporting period involves publication of the AERE Technical Report, vol. 23 by the SIU. 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 57 books and 11 journals 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 26 groups of delegates and visitors (comprising 1111 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

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. Bangladesh Government is going to establish a Nuclear Power Plant (NPP) at Rooppur in Pabna District. A good number of efficient manpower will be required to operate and maintain the plant. Considering all these necessities TI is conducting different kinds of training programs round the year as per the approval of BAEC.

Activities

1. Manpower Development and Training Program

Title of the event	Date	Place	No. of participants
In-house training course on general behavior and office courtesy	29-31 Jul. 2018	TI, AERE	41
Training Course on Radiation Protection for Radiation Workers and RCO's of BAEC, Medical Facilities and Industries	05-09 Aug. 2018	TI, AERE	28
Basic Nuclear Orientation Course-2018 (2nd Batch)	09 Sept. - 01 Nov. 2018	TI, AERE	21
7th FTC on Nuclear and Radiological Emergency Preparedness Course at BAEC	25 Nov.-6 Dec. 2018	TI, AERE	21
7th FTC on Environmental Radioactivity Monitoring Course at BAEC	13-17 Jan. 2019	TI, AERE	23
7th FTC on Reactor Engineering Course at BAEC	10-28 Feb.2019	TI, AERE	15
Training Course on Electronic Government Procurement (e-GP) System	31Mar. -04 Apr. 2019	TI, AERE	24
Basic Russian Language Course-2019	27Apr. -23 May 2019	TI, AERE	18
Training courses arranged outside TI for BAEC employees	Jan. - June 2019	RPATC	14

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

Name of the Participants	Title of the event	Organizer	Date	Place
Dr. M. N. Islam	13th Meeting of the Technical Working Group on Managing Human Resources in the Field of Nuclear Energy (TWG-MHR)	IAEA	25 - 27 Sept. 2018	IAEA, Austria
Dr. A. K. Das	Expert Meeting on the Coordination of Safety and Security Aspects for Establishing Synergy and Integration and Meeting of the Topical group on regulatory infrastructure	ANSN and IAEA	22-26 Oct. 2018	Kualalumpur, Malaysia
M. I. Chowdhury	National Policy Workshop on Development of Public Libraries in Bangladesh	Ministry of Cultural Affairs & British Council, Dhaka, Bangladesh	28 Apr. 2019	BICC, Dhaka

3. Stakeholder Meeting

Title of the event	Date	Place	No. of participants
Digital Service Design Lab. Organized by Ministry of Science and Technology, Govt. of Bangladesh	06-11 Jan. 2019	TI	33
Digital Service Design Lab. Organized by Ministry of Religious Affairs Govt. of Bangladesh	03-08 Feb. 2019	TI	29
Digital Service Design Lab. Organized by Ministry of Religious Affairs, Govt. of Bangladesh	03-08 Mar. 2019	TI	13
Digital Service Design Lab. Organized by Ministry of Planning, Govt. of Bangladesh	15-20 Apr. 2019	TI	25

4. Lecturer Delivered

- Dr. Md. Nurul Islam delivered a number of lecturers in the Basic Nuclear Orientation Course (BNOC) on Fundamentals of Neutron Radiography and its Applications.
- Dr. Ananda Kumar Das delivered series of lectures on i) Basics of Crystallography, ii) Materials Properties of a Nuclear Power Reactor, iii) Degradation of Materials in Nuclear Power Reactor, iv) Basics of Radiation Physics, v) Radiation Damage of Materials, vi) Disaster Management (Bangladesh perspective) in the Basic Nuclear Orientation Course (BNOC) and Follow up Training Courses (FTC) arranged in TI within 2018-19 fiscal year.

5. Training Courses Arranged Outside of TI for BAEC Employees

Title of the event	Date	Place	No. of participants
Fundamental Training Course	Jan.- June 2018	RPATC	9
Information and Communication Technology (ICT) Course	03-14 Mar. 2018	RPATC	1
General Behavior and Discipline	21-25 Apr. 2018	RPATC	1
e-nothi Course	07 -21 Apr. & 19-23 May 2018	RPATC	2
Communicative English Language course	12-23 Jun. 2018	RPATC	1

*Rural Public Adminstration Training Center (RPATC), New Eskaton, Dhaka

XIII. FINANCE AND ACCOUNTS DIVISION (FAD), HQ

Activities

1. Revenue Budget Allocation and Fund Release

(Taka in lac)

Code	Head of Accounts	Source of Fund 2018-2019			
		Allocation from Govt.	Received from BAEC own income	Received from Bank Interest	Total Received
3631101	Salary Support	7594.00	----	----	7594/-
3631102	Allowance Support	8718.44	----	----	8718.44/-
3631103	Goods and Service Support (Service Charge)	4717.56	3383.00	490.61	8591.17/-
3631107	Salary Grant	882.00	417.00	----	1299/-
	Grand Total	21912.00	3800.00	490.61	26202.61/-

2. Center/Institute Wise Revenue Budget Allocation

(Figure in lac Taka)

Name of the Centre/Institute	Revenue Budget Allocation
BAEC, Head Quarter, Dhaka	3145.61/-
Works Branch, BAEC, Dhaka	1116/-
BAERA, Dhaka	413/-
Atomic Energy Centre, Dhaka	2523/-
AERE, Savar	6678/-
National Institute of Nuclear Medicine & Allied Sciences, Dhaka	998/-
Institute of Nuclear Medicine & Allied Sciences, Chattogram	243/-
Institute of Nuclear Medicine & Allied Sciences, Rajshahi	242/-
Institute of Nuclear Medicine & Allied Sciences, Dinajpur	196/-
Institute of Nuclear Medicine & Allied Sciences, Sylhet	166/-

Name of the Centre/Institute	Revenue Budget Allocation
Institute of Nuclear Medicine & Allied Sciences, Dhaka	530/-
Institute of Nuclear Medicine & Allied Sciences, Barishal	241/-
Institute of Nuclear Medicine & Allied Sciences, Khulna	232/-
Institute of Nuclear Medicine & Allied Sciences, Rangpur	261/-
Institute of Nuclear Medicine & Allied Sciences, Mymensing	344/-
Institute of Nuclear Medicine & Allied Sciences, Bogura	262/-
Institute of Nuclear Medicine & Allied Sciences, Cumilla	151/-
Institute of Nuclear Medicine & Allied Sciences, Faridpur	165/-
Institute of Nuclear Medicine & Allied Sciences, Midford	280/-
Institute of Nuclear Medicine & Allied Sciences, Cox's Bazar	85/-
Atomic Energy Centre, Chattogram	196/-
BSMEC, Cox's bazaar	131/-
RNPP, Pabna	204/-
RTML, Mongla	82/-
Pension & retirment benefit	4698/-
Foreign Exchange Branch, Dhaka	1100/-
Total	24682.61/-
Service Charge Distribution	1520/-
Grand total	26202.61/-

XIV. SUPERVISION OF THESIS

ATOMIC ENERGY CENTRE (AEC), DHAKA

Accelerator Facilities Division, AECD

1. Joint-Supervisor: Dr. M. J. Abedin, "Assessment of elemental concentration and radioactivity of baby food collected from local market using PIXE and gamma spectrometry techniques", MS thesis (Suvrajit Roy), Department of Computer Science and Telecommunication Engineering, Noakhali Science and Technology University, September, 2018.

Chemistry Division, AECD

2. Joint-supervisor: Dr. S. B. Quraishi, "Heavy metal in dust and plant leaves in Dhaka, Bangladesh: Possible health threat of urban population", M.Sc thesis (Student Name: Shajin Sultana), Department of Environmental sciences, Jahangirnagar University, 2018.
3. Joint-supervisor: Dr. S. B. Quraishi, "Assessment of trace metals contamination in water and sediment from near shore coast, Southern part of Bangladesh using pollution indices", B. Sc. thesis (Arafat Rahman Khan), Department of Zoology Faculty of Life and Earth Science, Jagannath University, 2018.
4. Joint-supervisor: Dr. S. B. Quraishi, "An integrated approach for drinking water quality assessment in Dacope Upazila, Khulna", M.Sc thesis (Hafizur Rahman), International Centre for Climate Change and Development (ICCCAD), Independent University, Bangladesh (IUB), 2018.
5. Joint-supervisor: Dr. S. B. Quraishi, "Utility of serum copper level estimation in patients suffering from alzheimer's disease", MD Thesis (Dr. Dewan Mushfiqur Rahman), Department of Neurology, Bangabandhu Sheikh Mujib Medical University (BSMMU), 2019.
6. Joint-supervisor: Dr. S. B. Quraishi, "Association of a-amylase activity with Glycated Hemoglobin and Trace Elements in Impaired Glucose Metabolism", M.Pharm. (Dewan Ashik Mahmud), Department of Pharmacy, Noakhali Science and Technology University, April 2019.
7. Joint-supervisor: Dr. S. B. Quraishi, "Study of essential and toxic elements in fruits and evaluation of food value for Bangladesh people", MS thesis (Anita Akther), Department of Food and Nutrition, College of Home Economics, Azimpur, Dhaka & Department of Cell Biology & Molecular Genetics, Bangladesh Institute of Research & Rehabilitation in Diabetes Endocrine & Metabolic Disorder (BIRDEM), 2019.
8. Joint-supervisor: Dr. S. B. Quraishi, "Evaluation of organ-specific trace metal concentrations and human health risk considering different ages of Labeo calbasu and ompok pabda collected from aquaculture fish of Mymensingh area, Bangladesh", MS thesis (Shaika Shawkat), Department of Fisheries, University of Dhaka, 2019.
9. Joint-supervisor: Dr. S. B. Quraishi, "Dietary intake of essential and toxic metals through the consumption of rice and possible human health risk assessment in Bangladesh", MS thesis, (Farzana Sharmin Tonni), Department of Food and Nutrition, College of Home Economics, Azimpur, Dhaka & Department of Cell Biology & Molecular Genetics, Bangladesh Institute of Research & Rehabilitation in Diabetes Endocrine & Metabolic Disorder (BIRDEM), 2019.
10. Joint-supervisor: Dr. S. B. Quraishi, "A comprehensive assessment of trace metals contamination in water, sediment and fish species of various habitat preferences and trophic guilds from the Brahmaputra River", MS thesis (Sabikunnahar Shorna), Department of Fisheries, University of Dhaka, March 2019
11. Joint-supervisor: B. A. Begum, "Heavy metals emission from traditional and improved cooking stoves in Barishal, Bangladesh", B.Sc Thesis (M. R. Sarkar Pavel), Department of Chemistry, Dhaka University (DU), May 2019.
12. Co-supervisor: B. A. Begum, "Distribution of heavy metal in road dust collected from highway, Dhaka", M.Sc Thesis (Farzana Elaf), Department of Chemistry, University of Dhaka, January 2019.
13. Co-supervisor: B. A. Begum, "Concentration of polycyclic aromatic hydrocarbones (PAHs) Gazipur air, Dhaka", MS Thesis (Anika Tabassum), Department of Chemistry, University of Dhaka, January 2019.

14. Co-supervisor: B. A. Begum, "Investigation of indoor air quality from EPZ industrial Zone, Dhaka", M.Sc Thesis (Noshin Anjum Kamal), Department of Physics, Jahangirnagar University, August 2018.
15. Joint-supervisor: Y. N. Jolly, **"**Potential human health risk of poultry chickens", M.Sc Thesis (Nur Hussain Sagor), Department of Environmental Sciences, Jahangirnagar University, May 2019.
16. Joint-supervisor: Y. N. Jolly, **"**Assessment of heavy metal in surface sediments and selected fish in Tanguor Haor, Sylhet", B.Sc (Hon's) Thesis (Md. Moudud Ahmed), Deptment of Fisheries and Marine Science, Noakhali Science and Technology University, July 2018.
17. Joint-supervisor: Y. N. Jolly, **"**Heavy metal sediment saltmash in the Bangladesh coast", B.Sc (Hon's) Thesis (Md. Refat Jahan Rakib), Deptment of Fisheries and Marine Science, Noakhali Science and Technology University, November 2018.
18. Joint-supervisor: Y. N. Jolly, **"**Energy dispersive x-ray fluoresence detection of heavy metal in soil near an industrial zone**"**, M.Sc Thesis (Md. Sadman Sakib), Department of Physics, Jahangirnagar University, August 2018.
19. Joint-supervisor: Y. N. Jolly, **"**Accumulation of heavy metal in vegetables and possible health risk assessment", M.Sc Thesis (Md. Ashemus Shahadat), Department of Physics, Jahangirnagar University, August 2018.
20. Joint-supervisor: Y. N. Jolly, **"**Diatery intake of heavy metal due to consumption of fishes of buriganga river of Bangladesh and possible health risk assessment", MS Thesis (Shahida Sultana), Department of Chemistry, University of Dhaka, January 2019.
21. Joint- supervisor: Y. N. Jolly, **"**Analysis of heavy metal content in some fishes taken from Buriganga river of Bangladesh and possible health risk assessment", MS Thesis (Sadia Afreen suruvi), Department of Chemistry, University of Dhaka, January 2019.
22. Joint- supervisor: Y. N. Jolly, **"**A comparative study of heavy metal exposure risk from the consumption of some common varity of cultured and captured fishes of Bangladesh", MS. Thesis (Md. Ruzlan Habib), July 2018.
23. Joint-supervisor: Dr. M. S. Rahman, "Understanding the fog water composition and sources at an island location (Bhola- Bangladesh)", MS Thesis (Kamrun Nahar), Department of Chemistry, Dhaka University (DU), January 2019.
24. Joint-supervisor: Dr. M. S. Rahman, "Heavy metals contamination in sediment of Meghna River, Bangladesh", MS Thesis (Bivor Chandra Ray), Department of Chemistry, Dhaka University (DU), January 2019.
25. Joint-supervisor: Dr. M. S. Rahman, "Health risk assessment of toxic heavy metals in dust particles of different schools in Dhaka city, Bangladesh", MS Thesis (A. M. Al-Mamun), Department of Chemistry, Dhaka University (DU), January 2019.
26. Joint-supervisor: Dr. M. S. Rahman, "Heavy metal contamination of energy stimulating herbal preparation formulated in Bangladesh", MS Thesis (Begum Tahmina), Department of Nutrition and Food Technology, Jessore University of Science & Technology (JUST), December 2018.
27. Joint-supervisor: Dr. M. S. Rahman, "Investigation of trace and heavy metals in total suspended particles at Barishal Division, Bangladesh", B.Sc Thesis (A. K. M. Nayem), Department of Chemistry, Dhaka University (DU), May 2019
28. Joint-supervisor: Tasrina Rabia Choudhury, "Accumulation of metals in some insects of tannery and non-tannery areas in and around Dhaka city", MS Thesis (Antara Sarker Adhri), Department of Zoology, University of Dhaka, July 2018.
29. Joint-supervisor: Tasrina Rabia Choudhury, "Hydrochemical investigation of groundwater quality and human health risk: A case study of Noakhali Sadar Upazila, Noakhali, Bangladesh", B.Sc Thesis (Fatema Shormin Orni), Department of Environmental Science and Disaster Management, Noakhali Science and Technology University, Bangladesh, December 2018.
30. Joint-supervisor: Tasrina Rabia Choudhury, "Investigation of hydrogeochemistry and ground water quality of Subarnachar Upazilla, Noakhali, Bangladesh", B.Sc Thesis (Sharmina Faruk), Department of

Environmental Science and Disaster Management, Noakhali Science and Technology University, Bangladesh, December 2018.

31. Joint-supervisor: Tasrina Rabia Choudhury, "Adsorptive remediation of hexavalent chromium from aqueous solution by ZnCl2 activated rice husk", MS Thesis (Samia Sultana), Department of Applied Chemistry and Chemical Engineering, University of Dhaka, March, 2019.
32. Supervisor**:** A. R. M. Tareq, " Polycyclic aromatic hydrocarbons (PAHs) in some selected tea brands and possible human health risk implication in Bangladesh", M.Sc Thesis (Jahrun Afsana), Department of Food and Nutrition, College of Home Economics, DU, April 2019.

Experimental Physics Division, AECD

33. Supervisor: Dr. K. M. A. Hussain, "Fabrication and characterization of Sn doped ZnS thin film for application of buffer layer in solar cell", M.Sc Thesis (Farzana Akter Sohaly), Department of Electrical and Electronic Engineering, University of Dhaka, July 2018.
34. Joint-Supervisor: Dr. K. M. A. Hussain, "Synthesis of pure and Cu Doped (at. 1%) CdS nanostructured thin film and compare the characteristics for opto-electronic application", M. Sc Thesis (Mahedi Hasan), Department of Electrical and Electronic Engineering, University of Dhaka, July 2018.
35. Joint-Supervisor: Dr. M. T. Chowdhury, "Opto-electronic characterization of Cu doped ZnO nanoparticles and thin film", M.Sc Thesis (Tasnim Kamal), Department of Electrical and Electronic Engineering, University of Dhaka, July 2018.
36. Joint-Supervisor: Dr. K. M. A. Hussain, "Investigating the effect of Cu doping of thin CdS layer", M.Sc Thesis (Farjana Akter Jhuma), Department of Electrical and Electronic Engineering, University of Dhaka, December 2018.
37. Joint-Supervisor: Dr. K. M. A. Hussain, "Effect of thickness on zharacteristics of Zinc selenide (ZnSe) thin film synthesized by thermal vacuum evaporation technique", MS Engineering Thesis (Md. Abu Sayeed), Department of Electrical and Electronic Engineering, Faculty of Engineering, University of Chittagong, January 2019.
38. Joint-Supervisor: Dr. K. M. A. Hussain, "Synthesis and characterization of Zinc selenide thin film semiconductor by thermal evaporation technique", Master of Philosophy (M. Phil) Mohammad Mahbubur Rahman, Department of Physics, Dhaka University of Engineering and Technology, Gazipur, Bangladesh, April 2019.

Health Physics Division, AECD

39. Joint- supervisor: S. Yeasmin, "Assessment of natural and artificial radionuclides in powdered milk sample commonly consumed in Bangladesh", MS Thesis (Mohammad Mahtabul Kabir), Department of Nuclear Engineering, University of Dhaka, September 2018.
40. Joint-supervisor: S. Yeasmin, "Measurement of the activity concentration of natural radionuclides in soil samples and associated health hazards in Magura District, Bangladesh", MS Thesis (Md. Sumon Hassan), Department of Nuclear Engineering, University of Dhaka, September 2018.
41. Joint- supervisor: S. Yeasmin, "Measurement of gross alpha activity in tap and tube well water samples collected from old Dhaka by using Zinc Sulphide scintillation detector", MS Thesis (Mohammad Fahimul Islam), Department of Nuclear Engineering, University of Dhaka, September 2018.
42. Joint-supervisor: Dr. M. S. Rahman, "Real-time environmental gamma radiation measurement in Ramna Thana by in-situ method", MS Thesis (Md. Sujon Mian), Department of Physics, MBSTU, August 2018.
43. Joint-supervisor: Dr. M. S. Rahman, "Real-time gamma radiation measurement in INMAS Mitford Hospital campus by in-situ method", MS Thesis (Md. Durul Huda), Department of Physics, MBSTU, August 2018.
44. Joint-supervisor: Dr. M. S. Rahman, "Real-time environmental gamma dose rates measurement in Motijheel Thana by in-situ method", MS Thesis (Mohammed Belayet Hossain), Department of Environmental Sciences, JU, August 2018.

45. Joint-supervisor: J. Ferdous, "Assessment of activity concentration in medicinal plants of Bangladesh", MS Thesis (Shamima Sultana), Department of Physics, University of Rajshahi, December 2018.
46. Joint supervisor: Dr. A. K. M. Mizanur Rahman, "Comparison of thermoluminescence response of different types of TLDs in radiation dosimetry", B.Sc (Hons) Thesis (Kazi Md. Mehedi Hasan), Department of Nuclear Engineering, Dhaka University, September 2018.
47. Joint supervisor: Dr. A. K. M. Mizanur Rahman, "Thermoluminescence responses of TLD-100 subjected to low dose irradiation", B.Sc (Hons) Thesis (Yasmin Akter), Department of Nuclear Engineering, Dhaka University, September 2018.

Materials Science Division, AECD

48. Co-supervisor: Dr. Engr. S. M. Hoque, "Synthesis of hydroxyapatite by wet chemical precipitation method and characterization of hydroxyapatite-chitosan-gelatin based bone scaffold for biomedical application", M.Sc. Thesis (Sajib Kumar Mohonta), Department of Physics, University of Dhaka, December 2018.
49. Co-supervisor: Dr. Engr. S. M. Hoque, "Synthesis of Iron-Oxide (α- Fe_2O_3) nanoparticle by hydrothermal process and study the viability of chitosan coated particle in hyperthermia of cancer treatment", M.Sc. Thesis (Nandita Deb), Dept. of Physics, University of Dhaka, December 2018.
50. Co-supervisor: Dr. Engr. S. M. Hoque, "Synthesis of hydroxyapatite particle by hydrothermal method and a study of pysichemical properties of hydroxyapatite-gelatin-chitosan composite scaffolds for bone tissue engineering". M.Sc. Thesis (Tasnim Ara Sushmi), Dept. of Applied Chemistry & Chemical Engineering, University of Dhaka, 20 March 2019.
51. Co-supervisor: Dr. Engr. S. M. Hoque, "Synthesis of nano-sized Magnesium Ferrite ($MgFe_2O_4$) using chemical co-precipitation method and coated with chitosan for viability of hyperthermia for cancer treatment", M.Sc. Thesis (Mamun Ali Mondal), Dept. of Applied Chemistry & Chemical Engineering, University of Dhaka, March 2019.
52. Co-supervisor: Dr. Engr. S. M. Hoque, "Preparation of Zinc substituted Cobalt Ferrite nanoparticles by sol-gel process and coated with dextran for MRI contrast of brain and cancer treatment by hyperthermia", M.Sc. Thesis (Samin Anjum) Dept. of Applied Chemistry & Chemical Engineering, University of Dhaka, March 2019.
53. Co-supervisor: Dr. Engr. S. M. Hoque, "Synthesis of hydroxyapatite by wet chemical precipitation method and development of hydroxyapatite-chitosan-gelatin based bone scaffold for bone tissue engineering", M.Sc. Thesis (Mihir Ahmed), Dept. of Applied Chemistry & Chemical Engineering, University of Dhaka, March 2019.
54. Co-supervisor: Dr. Engr. S. M. Hoque, "Synthesis of Nickel Ferrite ($NiFe_2O_4$) nanoparticle by Sol-gel auto combustion method and study the Magnetocaloric effect (MCE) for using it as Magnetocaloric material (MCM) in Magnetic Refrigeration", M.Sc. Thesis (Prodip Das), Dept. of Nucler Engineering, University of Dhaka, January 2019.
55. Co-supervisor: Dr. Engr. S. M. Hoque, "Synthesis of Magnesium Ferrite ($MgFe_2O_4$) nanoparticle by sol-gel auto-combustion process and study of magneto caloric effect (MCE) as a magnetic materials for magnetic refrigeration and heating", M.Sc. Thesis (Mohammed Sahadat Hossain), Dept. of Nucler Engineering, University of Dhaka, January 2019.
56. Co-supervisor: Dr. Engr. S. M. Hoque, "Study of the microstructural and magnetic properties of the spinel ferrite nanoensembles and their biomedical applications", Ph.D Thesis (Md. Khairul Islam), Dept. of Nuclear Engineering, University of Dhaka, January 2019.
57. Co-supervisor: Engr. F. M. Kamal, "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", M.Sc. Thesis (Umma Habiba Tanni), Dept. of Physics, Cumilla University, April 2019.
58. Co-supervisor: Engr. F. M. Kamal, "Synthesis and magnetoelectric characterization of Sr-Substituted Ni-Zn ferrites", M.Sc. Thesis (Antara Tazrin Trina), Dept. of Physics, Cumilla University, April 2019.

59. Co-supervisor: Dr. M. N. I. Khan, "Synthesis of (1-x)$BaTi_{0.5}Mn_{0.5}O_3$-(x) $_{0.6}Zn_{0.4}Fe_{1.85}O_4$ composites via double sintering ceramic technique and investigation of its multiferroic properties", M.Sc. Thesis (Khairunahar Munny), Department of Physics, University of Dhaka, December 2018.

60. Co-supervisor: Dr. M. N. I. Khan, "Synthesis and characterization of the structural, electrical and magnetic properties of Calcium, Strontium and Manganese substituted Barium Titanate ($BaTiO_3$) ceramics", MS Thesis (Ayesha Akhter), Dept. of Physics, University of Dhaka, December 2018.

61. Co-supervisor: Dr. M. N. I. Khan, "Green synthesis of bio-molecules encapsulated magnetite nanoparticles and their bio-medical applications", M.Sc. Thesis, Dept. of Physics, University of Dhaka, December 2018.

62. Co-supervisor: Dr. M. N. I. Khan, "Synthesis and investigation of structural, magnetic and transport properties of Ba_{1-} $Zr_xTi_{0.98}Y_{0.02}O_3$ ceramics", M.Sc. Thesis (Sharmin Akhter), Dept. of Physics, University of Dhaka, April 2019.

63. Co-supervisor: Dr. M. N. I. Khan, "Influence of rare earth (Y) ion substitution on the structural, electrical and magnetic properties of Cobalt-Zinc ferrites", M.Phil Thesis (Mithila Das), Dept. of Physics, Chittagong University of Engineering and Technology, 2019.

64. Co- supervisor: Dr. M. A. Mamun, "Synthesis, chracterization and properties of graphene reinforced copper doped Yttria stabilized Zirconia nanocomposites", B.Sc. Thesis (K. M. R. B. Zaman, M. F. Shahriar and S. S. Haque), Department of Nuclear Science and Engineering, Military Institute of Science and Technology, December 2018.

Plasma Physics Division, AECD

65. Joint-supervisor: Dr. M. K. Islam, "Numerical experiments to study the effect of the variation of gas pressure on the plasma dynamics of PF-1000 plasma focus machine", B.Sc Thesis (Lima Akter), Department of Nuclear Engineering, University of Dhaka, Dhaka, Bangladesh, December 2018.

66. Joint-supervisor: Dr. M. K. Islam, "Numerical experiments using lee model code to study the effect of variation of gas on the DPF machine plasma properties", B.Sc Thesis (Golam Sarwar Rakib), Department of Nuclear Engineering, University of Dhaka, Dhaka, Bangladesh, December 2018.

Medical Physics Division, AECD

67. Co-supervisor: Dr R. Khatun, "Comparative studies of absorbed dose in water phantom, solid water phantom and matrix with MULTI cube phantom", M.Sc Thesis (Tusher Kumer), Department of Physics, Pabna University of Science and Technology (PUST), June 2019.

ATOMIC ENERGY CENTRE (AEC), CHATTOGRAM

68. Co-supervisor: Dr. S. Hossain, "Investigation on mass concentration of natural radionuclides and heavy metals in coastal ecosystem of Kutubdia Island, Cox's Bazar, Bangladesh", M.Phil Thesis (Nazim-Ud-Doulah), Department of Chemistry, Chittagong University of Engineering & Technology, November 2018.

69. Co-supervisor: Dr. S. Hossain, "Study of some heavy metals in tobacco leaves of Chakaria Area and its cultivation impact on soil and water of the surrounding of Cox's Bazar, Bangladesh", MS Thesis (Rohit Das), Department of Chemistry, Govt. Hazi Mohammad Mohsin College, February 2019.

70. Co-supervisor: Dr. S. Hossain, "Ionizing radiation shielding effectiveness of mortar used for construction in Bangladesh", B.Sc Project (Md. Jakaria Faysal & Md. Maruful Alam), Department of Civil Engineering, CUET, June 2019.

CENTRE FOR RESEARCH REACTOR (CRR), AERE

71. Supervisor/Co-supervisor: Dr. M. A. M. Soner, "Study on response calculation on reactor operation with experimental validation of BTRR", B.Sc Thesis (Nazmul Hossain), Department of Nuclear Engineering, Dhaka University, September 2018.

72. Supervisor/Co-supervisor: Dr. M. A. M. Soner, "Study on reactivity balance and instrumentation validation of the BAEC TRIGA Research Reactor", B.Sc Thesis (Farhana Islam Farha), Department of Nuclear Engineering, Dhaka University, September 2018.

73. Supervisor/Co-supervisor: M. M. Rahman, "Burn up estimation of BAEC TRIGA research reactor using a computer code", Project Thesis (Md. Shafiul Hossain), Department of Physics, Pabna University of Science and Technology, 2018.
74. Supervisor/Co-supervisor: A. Rahman, "Steady state thermal hydraulic analysis using numerical method of BAEC TRIGA research reactor", M.Sc. Thesis (Amit Mazumder), Department of Physics, Jagannath University, 2018.

INSTITUTE OF RADIATION AND POLYMER TECHNOLOGY (IRPT), AERE

75. Supervisor/Co-supervisor: Dr. R. A. Khan and M. Razzak, "Fabrication and characterization of bio-degradable films using PVA and gelatin: Effect of nanocrystalline cellulose and gamma radiation", M.Sc. Thesis (Nanda Karmaker), Department of Applied Physics, Dhaka University, 2018.
76. Supervisor/Co-supervisor: Dr. R. A. Khan and M. Razzak, "Fabrication and characterization of glass fiber reinforced epoxy resin and heavy minerals based composite materials for radiation shielding", M.Sc. Thesis (Md. Borhan Uddin), Dept of Mechanical Engineering, DUET, Gazipur, January 2019.
77. Supervisor/Co-supervisor: Dr. R. A. Khan, M. Razzak, "Preparation and characterization of superabsorbent hydrogel from acrylic acid and polyethylene oxide by gamma radiation and its application on desalination of water", M.Sc. Thesis (Tania Sobnom), Dept of Applied Chemistry and Chemical Technology, NUST, Noakhali, July 2018.
78. Supervisor/Co-supervisor: Dr. R. A. Khan, M. Razzak, "Assessment of water quality parameters and treatment of the Meghna river water of Bhairab Bazar, Kishoreganj, Bangladesh", M.Sc. (Md. Sharif Hossan), Dept of Applied Chemistry and Chemical Technology, NUST, Noakhali, July 2018.
79. Supervisor/Co-supervisor: Dr. R. A. Khan, M. B. Uddin, "Preparation and characterization of jute-based thermo-set composites", B.Sc. Thesis (Md. Yusuf Ali), Dept of Applied Chemistry and Chemical Technology, KYAU, Sirajganj, July 2018.
80. Supervisor/Co-supervisor: Dr. R. A. Khan, "Preparation of ceramic nano-particles dispersed polymer matrix composites: Comparison of physico-chemical characteristics", M.Sc. Thesis (Tayebur Rahman), Dept. of Material Science and Engineering Division, Rajshahi University, August 2018.
81. Supervisor/Co-supervisor: Dr. R. A. Khan, M. Razzak, "Development of E-glass fiber reinforced synthetic matrix composites: Effect of gamma radiation", M.Sc. Thesis (Manjurul Haque), Dept. of Material Science and Engineering Division, Rajshahi University, RU, September 2018.
82. Supervisor/Co-supervisor: Dr. R. A. Khan, M. Razzak, "Fabrication and performance study of a composite materials to protect from gamma radiation", B.Sc. Thesis (Md. Mahedi Hasan), Dept. of Nuclear Engineering, DU, September 2018.

INSTITUTE OF NUCLEAR SCIENCE AND TECHNOLOGY (INST), AERE

Nuclear Radiation and Chemistry Division, INST

83. Supervisors: Dr. N. Rahman And S. Sultana, "Methylene blue dye adsorption study using sodium styrene sulfonate and acrylic acid grafted non-woven polyethylene", B.Sc. Project Report (Abdul Halim and Md Imdadul Haque), Department of Chemistry, Mawlana Bhashani Science and Technology University, October 2018.
84. Supervisor: Dr. N. Rahman, "Development of adsorbent from sawdust for removal of heavy metals from tennery effluents", B.Sc Project Report (Abrar Shahriar), Institute of Leather Engineering and Technology, University of Dhaka, October 2018.
85. Joint-supervisor: Dr. N. C. Dafader and M. F. Alam, "Bioremediation of tannery effluents using bacteria (Bacillus cereus and agrobacterium tumefaciens) and aquatic plants (pistia stratiotes and eichhornia crassipes)", MS thesis (Khodeza Khatun), Department of Environmental Science and Resource Management, Mawlana Bhashani Science and Technology University, July 2018.
86. Supervisor: M. F. Alam, "Industrial training of reactor water properties", B.Sc. (Honour's) Internship Report (Tazneen Islam Shaon), Department of Nuclear Engineering, Dhaka University, August 2018.

87. Joint-supervisor: Dr. N. C. Dafader and M. F. Alam, "Detection and evaluation of some particular heavy metal contaminants in some commercially available natural health care products and nutraceuticals available in Bangladeshi Market", B.Sc. Project Report (A. K. M Mahmudullah, M. S. Islam and M. H. Islam), Department of Pharmacy, Gono Bishwabidyalay, October 2018.

88. Joint-supervisor: M. F. Alam, Co-supervisor: F. T. Ahmed, "Study on physico-chemical properties of some commonly consumed energy drinks in Bangladesh", B.Sc. (Honour's) Internship Report (Kazi Shabbir Ahamed and Shanto Kumer Saha), Department of Chemistry, Mawlana Bhasani Science and Technology University, December 2018.

89. Supervisor: F. T. Ahmed, "Report on industrial training at Atomic Energy Research establishment (AERE), Bangladesh Atomic Energy Commission, Ganakbari, Savar, Dhaka", B.Sc. (Honour's) 3rd year Internship Report (Md. Hasibul Islam Himel and Md. Nur A Alam Patwary), Department of Nuclear Engineering, Dhaka University, May 2019.

Health Physics and Radioactive Waste Management Unit, INST

90. Supervisor: Associate Prof. Dr. M. A. H. Bhuiyan, Co-supervisors: Supernumerary Prof. Dr. M. Khondker and Dr. K. Asaduzzaman, "Evaluation of Wetland Tanguar Haor at the rauar station with special referrence to its physico Chemical, Biological and Radiological components and conservation", MS Thesis (S. A. M. Shariar Islam) Department of Botany, University of Dhaka, Dhaka, Bangladesh, July 2018.

91. Supervisor: Associate Prof. Dr. M. A. H. Bhuiyan, Co-supervisors: Supernumerary Prof. Dr. M. Khondker and Dr. K. Asaduzzaman, "Water quality, biodiversity and conservation of Wetland Tanguar Haor at watch tower Station, Sunamganj", MS Thesis (Abu Kowser), Department of Botany, University of Dhaka, Dhaka, Bangladesh, July 2018.

92. Supervisor: Lecturer M. M. H. Prodhan, Co-supervisors: Dr. M. S. Rahman and T. Siddiqua, "Characterization of calibration x-ray beam for radiation protection and measurement", B. Sc Thesis (Md. Soleman Sajib), Department of Nuclear Engineering, University of Dhaka, Dhaka, Bangladesh, September 2018.

93. Supervisor: Associate Prof. Dr. M. S. Islam, Co-supervisors: Dr. M. Shamsuzzamanand, Dr. M. M. H. Bhuiyan, "Evaluation of excess cancer risk using RESRAD", B.Sc Thesis (Naimul Abrar), Department of Nuclear Engineering, University of Dhaka, Dhaka, Bangladesh, September 2018.

94. Supervisor: Lecturer M. J. Dewan, Joint-supervisors: Dr. M. Shamsuzzaman and Dr. M. M. H. Bhuiyan, "Study on the response of some radiation measurement devices with photon beam", B.Sc. Thesis (Shyam Saha), Department of Nuclear Engineering, University of Dhaka, Dhaka, Bangladesh, September 2018.

Reactor and Neutron Physics Division, INST

95. Supervisor/Co-supervisor: Dr. M. A. Islam, "Concentration and distribution of trace elements in sediments of the Padma river nearby Rooppur nuclear power plant project using neutron activation analysis", MS Thesis (Swapon Hossain), Department of Physics, Shahjalal University of Science and Technology, Sylhet, February 2019.

96. Supervisor/Co-supervisor: Dr. M. A. Islam, "Assessment of trace element contamination in sediments of the Madhumati River using neutron activation analysis", MS Thesis (Sourashubra Datta), Physics Discipline, Khulna University, Khulna, December 2018.

97. Supervisor/Co-supervisor: Dr. M. A. Islam, "Assessment of trace element contamination in sediment core of the rivers of Sundarban using neutron activation analysis", MS Thesis (Md. Rahat Ali), Physics Discipline, Khulna University, Khulna, December 2018.

98. Supervisor/Co-supervisor: Dr. R. Khan, "Investigating elemental concentration and potential contamination in Tista River sediment", MS Thesis (Md. Foysal Hassan), Department of Disaster Management, Begum Rokeya University, February 2019.

99. Supervisor/Co-supervisor: Dr. R. Khan, "Assessment of elemental contamination in Brahmaputra river sediment by instrumental neutron activation analysis", MS Thesis (Abu Shifat Md. Mucktadir), Department of Disaster Management, Begum Rokeya University, February 2019.

100. Supervisor/Co-supervisor: Dr. R. Khan, "Heavy metal contamination of Benthic sediment of Turag river near industrial effluent discharge location", MS Thesis (Sayeda Ummeh Masrura), Department of Civil Engineering (Environmental), Bangladesh University of Engineering & Technology, December 2018.

101. Supervisor/Co-supervisor: Dr. S. Hossain, "Synthesis and characterization of Tin doped Gadolinium cerate for intermediate temperature fuel cells", M.Sc. Thesis (Md. Mehedi Hasan), Department of Nuclear Engineering, University of Dhaka, February 2019.

Reactor Physics and Engineering Division, INST

102. Supervisor: Dr. M. J. H. Khan, "A study on integral parameters of VVER critical experiment lattices of light water reactors based on evaluated nuclear data library ENDF/B-VII.0 & JENDL-3.2", B.Sc. Thesis (K M Zaheen Nasir, Benozir Ahmed, Tanaya Chakma), Department of Nuclear Science and Engineering, Military Institute of Science and Technology, 2018.

Isotop Hydrology Division, INST

Report

103. A. Akbar, "Assessment of Pond/Lake water quality of different ponds inside the Atomic Energy Research Establishment (AERE) For Fish Cultivation", Mawlana Bhashani Science and Technology University, Santosh, Tangail, September 2018.

INSTITUTE OF FOOD AND RADIATION BIOLOGY (IFRB), AERE

Agrochemical and Environmental Research Division, IFRB

104. Supervisor/Co- supervisor: Dr. M. A. Uddin, "Determination of heavy metals in the Sea Beach water of Cox's Bazar and Saint Martin Island, Bangladesh", MS thesis (Md. Irfan Hossain), Department of Biochemistry & Molecular Biology, National University, September 2018.

Insect Biotechnology Division, IFRB

105. Co-supervisor: Dr. M. A. Hossain, "Population fluctuation monitoring of the Tephritid fruit flies (Diptera: Tepritidae: Dacinae) in two areas of Dhaka city", M.Sc. Thesis (Shohag Ahmmed), Department of Zoology, Jagannath University, July 2018.

106. Co-supervisor: Dr. M. A. Hossain, "Coleopteran insect diversity in some selected areas of Dhaka", M.Sc Thesis (Sadia Afroz), Department of Zoology, Jagannath University, July 2018.

107. Joint-supervisor: Dr. M. Khan, "Assessment of artificial larval diet and optimization of sterile male ratio of the peach fruit fly, Bactrocera zonata (Saunders) in support of Sterile Insect Technique", M.Sc. Thesis (Mahfuza Babul Mitu), Department of Zoology, Jagannath University, May 2019.

108. Joint-supervisor: Dr. M. Khan, "Use of protein bait, food attractant and male annihilation technique (MAT) for the management of Bactrocera fruit flies (Diptera: Tephritidae) in AERE campus, Ganakbari, Savar', M.Sc. Thesis (Zahidul Islam), Department of Zoology, Jagannath University, May 2019.

109. Joint-supervisor: M. A. Bari, "Efficacy of indigenous bacillus thuringiensis strains against the melon fly, Zeugodacus cucurbitae (Diptera: Tephritidae)", M.Sc. Thesis (Priyanka Bhowmic), Department of Zoology, Jagannath University, May 2019.

110. Joint-supervisor: M. A. Bari, "Toxicity study of indigenous bacillus thuringiensis strains against the oriental fly, bactrocera dorsalis (Diptera: Tephritidae)", M.Sc. Thesis (Lamia Islam), Department of Zoology, Jagannath University, May 2019.

Microbiology and Industrial Irradiation Division, IFRB

111. Joint-supervisor: Dr. M. K. Pramanik, "Studies on the antibacterial and enzyme immobilization potential of chitosan producedfrom pleurotus ostreatus", MS Thesis (Md. Tanvir Kabir), Department of Botany, Jahangir Nagar University, January 2019.

112. Joint-supervisor: Dr. T. Mumtaz, "Screening and molecular identification of poly-β-hydroxybutyrate (PHB) producing bacteria isolated from gamma irradiated textile wastewater", Dept of Biotechnology and Genetic Engineering, Faculty of Applied Science and Technology, Islamic University, September 2018.

113. Joint-supervisor: Dr. A. A. Mahin, "Partial characterization of bacteriocin produced by lactic acid bacteria isolated from chicken intestine", MS thesis (Banasree Bhowmik), Department of Microbiology, Noakhali Science and Technology University, December 2018.

INSTITUTE OF TISSUE BANKING AND BIOMATERIALS RESEARCH (ITBBR), AERE

114. Joint-supervisor: Dr. S. M. Asaduzzaman, "Isolation, enumeration, molecular characterization of bacteria from human amniotic membrane and determination of radiation sensitivity pattern of the isolates", M.Sc. Thesis (Md. Shajadur Rahman), Department of Microbiology, Jessore University of Science & Technology, January 2019.
115. Joint-supervisor: Dr. S. M. Asaduzzaman, "A comparative study among Silver Sulfadiazine, gamma irradiated amniotic membrane and curcumin derived gels for the assessment of faster burn and wound healing in wistar rat model", M.Sc. Thesis (Hafizur Rahman), Department of Biochemistry & Molecular Biology, Jahangirnagar University, Savar, Dhaka-1342, Bangladesh, April 2019.
116. Joint-supervisor: Dr. S. M. Asaduzzaman, "Formulation, evaluation and application of human amniotic membrane and honey derived gels to treat alloxan induced diabetic wound in rat model", M.Sc. Thesis (Md. Arifur Rahman), Department of Biochemistry & Molecular Biology, Jahangirnagar University, Savar, Dhaka-1342, Bangladesh, April 2019.
117. Joint-supervisor: Dr. S. M. Asaduzzaman, "Development of a biomimetic multilayered collagen based scaffold for bone tissue engineering", M.Sc. Thesis (Sadika-Tul-Jannat Tonu), Department of Biochemistry & Molecular Biology, Jahangirnagar University, Savar, Dhaka-1342, Bangladesh, April 2019.

INSTITUTE OF ELECTRONICS (IE), AERE

Nuclear Electronics Division, IE

118. Co-supervisor: M. F. Akter, "Automatic wireless wearable monitoring system using temperature sensor and pulse sensor in hospital for patients", B.Sc. Thesis (Kaniz Fatema Bipasha), Department of Medical physics and Biomedical Engineering, Gono University, Savar, Dhaka, 2018.

Solar Cell Fabrication and Research Division, IE

119. Joint-supervisor: M. A. R. Akand, "Analysis of electrical and performance of a poly crystalline silicon solar cell at outdoor conditions in Bangladesh", M.Sc. thesis (Al Rafsan Amin), Institute of Energy, University of Dhaka, September 2018.
120. Joint-supervisor: M. A. R. Akand, "Study and analysis of phosphorous diffusion process to fabricate a solar cell", M.Sc. Thesis (Abu Ahasan Md. Rafi), Institute of Energy, University of Dhaka, September 2018.
121. Joint-supervisor: M. K. Basher, "An efficient approach to form metal oxide nanostructure on stainless steel by the novel method of hot water treatment", M.Sc. Thesis (Asif Tanvir Bhuiya), Institute of Energy, University of Dhaka, September 2018.
122. Joint-supervisor: M. K. Basher, "Monocrystalline silicon solar cell; inverted pyramid texturing using metal-assisted chemical etching (MACE)", M.Sc. Thesis (Ramkrishna Mishan), Institute of Energy, University of Dhaka, August 2018.
123. Joint-Supervisor: M. K. Basher, "Study and analysis the effect of doping concentration variation on specific contact resistance of crystalline silicon solar cell", M.Sc Thesis (Shuvrodev Biswas), Institute of Energy, University of Dhaka, August 2018.

NATIONAL INSTITUTE OF NUCLEAR MEDICINE AND ALLIED SCIENCES (NINMAS), SHAHBAG

124. Supervisor: Prof. Dr. S. Sultana, "Assessment of agreement of wrist bone mineral density with spine and hip bone mineral density in postmenopausal women", M.Phil Thesis (Dr. Madhuchanda Hazra Mou), BSMMU, October 2018.
125. Supervisor: Prof. Dr. S. Sultana, "Serum vitamin D stutus in newly diagnosed hypothyroid patients", M.Phil Thesis (Dr. Nahid Khan), BSMMU, October 2018.

126. Supervisor: Prof. Dr. S. M. F. Begum, "18F FDG PET-CT Scan in the assessment of treatment response of diagnosed extra pulmonary tuberculosis", M.Phil Thesis (Dr. Fatema Tuz Zohra), BSMMU, October 2018.
127. Supervisor: Prof. Dr. S. Sultana, "Comparison of gates' method and CKD-EPI equation with plasma sample method for estimation of GRF", M.Phil Thesis (Dr. Suraya Sarmin), BSMMU, October 2018.
128. Supervisor: Prof. Dr. S. M. F. Begum, "Myocardial perfusion imaging in the evaluation of outcome of coronary intervention in coronary artery disease patients", M.Phil Thesis (Dr. Sanhita Majumder), BSMMU, October 2018.
129. Supervisor: Prof. Dr. F. Nasreen, "Role of duplex ultrasound for the assessment of malignancy in breast tumors compared to Histopathology", M.Phil Thesis (Dr. Anindita Rani Paul), BSMMU, October 2018.
130. Supervisor: Prof. Dr. S. M. F. Begum, "Efficacy of SPECT myocardial perfusion imaging (MPI) in combination with coronary artery calcium (CAC) Score for the diagnosis of coronary artery disease (CAD)", M.Phil Thesis (Dr. Dilruba Amin), BSMMU, October 2018.
131. Supervisor: Prof. Dr. F. Begum, "Value of PET-CT Staging in lymphoma patients at baseline over clinical staging", M.Phil Thesis (Dr. Tasnim Ahmed), BSMMU, October 2018.
132. Co-supervisor: Prof. Dr. F. Begum, "Measurement of bone mineral density in the transfusion dependent thalassaemic patients", MD, Hematology Student (Dr. Showrab Biswas), Phase B, BSMMU, January 2019.

XV. NATIONAL/INTERNATIONL PUBLICATIONS

ATOMIC ENERGY CENTRE (AEC), DHAKA

Chemistry Division, AECD

International

1. Y. N. Jolly, S. Rana, S. Akter, J. Kabir, M. S. Rahman, M. M. Rahman and M. S. Sultana, "Appraisal of metal pollution in the aquatic environment of Shitalakhya River, Bangladesh and its ecological risk assessment", J. Nature Sc. Sust. Technol., **12** (2019) 4.
2. M. S. Rahman, M. D. H. Khan, Y. N. Jolly, J. Kabir, S. Akter and A. Salam, "Assessing risk to human health for heavy metal contamination through street dust in the Southeast Asian Megacity: Dhaka, Bangladesh", Sci. of the Total Environ., **660** (2019) 1610–1622.
3. F. Chena, J. Hub, Y. Takahashic, M. Yamada, M. S. Rahman and G. Yang, "Application of synchrotron radiation and other techniques in analysis of radioactive microparticles emitted from the Fukushima Daiichi Nuclear Power Plant accident-A review", Journal of Environ. Radio., **196** (2019) 29–39, https://doi.org/10.1016/j.jenvrad. 2018.10.013
4. M. S. Rahman, M. S. Hossain, M. K. Ahmed, S. Akther, Y. N. Jolly, S. Akhter, M. J. Kabir and T. R. Choudhury, "Assessment of heavy metals contamination in selected tropical marine fish species in Bangladesh and their impact on human health", Environ. Nanotechno. Monito. & Manag., **11** (2019) 100210. https://doi.org/10.1016/ j.enmm.2019.100210
5. M. S. Ahman, M. B. Hossain, S. M. O. F. Babu, M. Rahman, A. S. S. Ahmed, Y. N. Jolly, T. R. Choudhury, B. A. Begum, J. Kabir and S. Akter, "Source of metal contamination in sediment, their ecological risk, and phytoremediation ability of the studied mangrove plants in ship breaking area, Bangladesh", Marine Poll. Bulletin, **141** (2029) 137–146. https://doi.org/ 10.1016/j.marpolbul. 2019.02.032
6. M. B. Doza, M. I. Muhib, M. S. Rahman, M. A. H. Bhuiyan, M. A. Rakib, S. B. Quraishi and S. M. D. Islam, "Delineation of trace metals contamination in groundwater using geostatistical techniques: a study on Dhaka City of Bangladesh", Groundwater for Sustainable Develop., **9** (2019) 100212, https://doi.org/10.1016/j.gsd.2019.03.006.
7. G. Yang, M. S. Rahman, H. Tazoe, J. Hu, Y. Shao and M. Yamada, "^{236}U and radiocesium in river bank soil and river sediment in Fukushima Prefecture, after the Fukushima Daiichi Nuclear Power Plant accident", Chemosphere, **225** (2019) 388-394. https://doi.org/10.1016/ j.chemosphere.2019.03.061

8. S. Akter, S. M. A. Islam, M. O. Rahman, K. M. Mamun, M. J. Kabir, M. S. Rahman, B. A. Begum, M. J. Abedin, S. I. Tushar and Y. N. Jolly, "Toxic elements accumulation in vegetables from soil collected from the vicinity of a fertilizer factory and possible health risk assessment", Bio. Eng. & Bio. Sci., **3(2)** (2019). DOI:10.32474/OAJBEB.2019.03.000159.

9. M. D. H. Khan, A. Talukder and M. S. Rahman, "Spatial distribution and contamination assessment of heavy metalsin urban road dusts from Dhaka city, Bangladesh", IOSR Journal of App. Chem., **11(1)** (2018) 90-99. DOI: 10.9790/5736-1101019099.

10. N. Saha and M. S. Rahman, "Multivariate statistical analysis of metal contamination in surface water around Dhaka export processing industrial zone, Bangladesh, Environ. Nanotechnol. Monito. & Manag.", **10** (2018) 206-211, https://doi.org/10.1016/j.enmm.2018. 07.007

11. M. B. Dozaa, M. A. H. Bhuiyan, S. M. D. Islam, M. S. Rahman, M. M. Haque, K. J. Fatema, N. Ahmed, M. A. Rakib and M. A. Rahman, "Hydrogeochemical investigation of groundwater in Dhaka City of Bangladesh using GIS and multivariate statistical techniques, Groundwater for Sustainable Develop.", **8** (2018) 226-244, https://doi.org/10.1016/j.gsd. 2018.11.008

12. M. S. Ali, B. A. Begum, S. Akhter, K. Nigar, U. K. M. Uddin, S. Akter and Y. N. Jolly**,** "Evaluation of Blood Lead Level as a Risk Factor in Children with Autism Spectrum Disorder: A Case Control Study", J Blood Disord Transfus, **9** (2018) 4, DOI: 10.4172/2155-9864.1000414.

13. M. M. Hossain, S. Nahar, T. R. Choudhury, M. Shahriar, N. Uddin, A. F. M. Mahmudul Islam, A. Sarker and P. Saha, "Studies of heavy metal contents and microbial profile in selected pediatric oral liquid preparations available in Bangladesh", Journal of Phar. Res. Int., **21(4)**,2018, pp1-15.

14. S. Zaman, M. K. Hasan, S. Khanom, T. R. Choudhury and M. M. Kabir, "Assessment of water and sediment quality of Noakhali Canal, Noakhali, Bangladesh", Int. Journal of Environ. Sci. and Natural Resources, **17(3)**, 2019.

15. A. K. M. A. Ullah, M. F. Kabir, A. N. Tamanna, A. Hossain, A. R. M. Tareq, M. N. I. Khan, A. K. M. F. Kibria, M. Kurasaki and M. M. Rahman, "Green synthesis of bio-molecule encapsulated magnetic silver nanoparticles and their antibacterial activity", The Royal Society of Chem., **8** (2018) 37176 – 37183.

16. 21. A. K. M. A. Ullah, A. N. Tamanna, A. Hossain, M. F. Kabir, M. Akter, A. R. M. Tareq, A. K. M. F. Kibria, M. Kurasaki, M. N. I. Khan and M. M. Rahman, "In vitro cytotoxicity antibiotic and application of green route surface modified ferromagnetic TiO_2 nanoparticles", RSC Adv, **l9** (2019) 13254 – 13262.

17. A. K. M. A. Ullah, M. A. Maksud, S. R. Khan and S. B. Quraishi, "Morning (First) urine copper concentration: A new approach for the diagnosis of Wilson's Disease", Bio. Trace Element Res., **190** (2019) 283-288.

National

18. T. Ahmed, A. K. M. A. Morshed, T. R. Choudhury, M. S. R. Khan and M. Begum, "Serum Lead level in children with acute leukemia", Bangladesh J Child Health, **42(1)** (2018) 26-29.

Accelerator Facilities Division, AECD

International

19. S. Roy, N. Akter, M. J. Abedin, R. Khatun and S. Akter, "Assessment of Elemental Concentration of Milk Powder Collected From Local Market Using PIXE Technique", IOSR Journal of App. Phys., **11(2)**, (March 2019), 22-26.

Electronics Division, AECD

International

20. M. A. A. Mamun, H. Furuta and A. Hatta, "Pulsed-DC discharge for plasma CVD of Carbon thin films", IEEE Transactions on Plasma Sci., **47(1)** (2019) 22-31.

21. M. N. Islam, H. Akhter, M. Begum and M. Kamal, "Comprehensive review of the investigation of anthropogenic and naturally occurring radionuclides in different parts of Bangladesh", Int. J. of Adv. Eng., Mgt. and Sci., **4(7)** (2018) 490-495.

22. M. N. Islam, H. Akhter, R. Rashid, M. S. Alam, M. Hoq, T. Fujiwara, S. Kenji and H.Takahashi, "Neutron imaging and tomography with Medipix2 and dental microroentgenography: An Over View", Int. J. of Adv. Eng., Mgt. and Sci., **5(1)** (2019) 01-04.
23. M. N. Islam and H. Akhter, "Study of FPGA based multi-channel analyzer for gamma-ray and x-ray spectrometry", Int. J. of Trend in Sci. Res. and Develop., **3(3)** (2019) 61-65.

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24. M. T. Khatun**,** M. R. Rahman, M. S. Hossain, M. Ali, M. A. Momin and M. M. Alam, "Synthesis and characterization of Copper (I) Iodide nanoparticles and embedded in polymer matrix for optoelectronics application", Journal of Appl. Sci. and Technol., **11(1)** (February 2019) 57-64.
25. M. Islam, M. R. Rahman**,** M. T. Khatun, M. A. Momin and M. M. Alam, "Synthesis and characterization of graphene oxide synthesized via electrochemical method", Journal of Appl. Sci. and Technol., **11(1)** (February 2019) 65-70.

Experimental Physics Division, AECD

International

26. T. Chakrabortty, S. Mina, K. M. A. Hussain, T. Faruque and F. Nahid, "Fabrication and characterization of Al Doped ZnO thin film using spin coating deposition system", IOSR Journal of Appl. Phys., **10(3)** (2018) 2278-4861.
27. S. Islam, K. M. A. Hussain and M. J. Rashid, "Deposition and optical characterization of ZnO thin films on glass substate", Int. Journal of Phys., Conference Series, **1086** (2018) 1-5.
28. M. A. Zubair, M. A. Chowdhury, M. S. Bashar, M. A. Sami and M. A. Islam, "Thickness dependent correlation between structural and optical properties of textured CdSe thin film", AIP Advances, **9** (2019) 045123.
29. I. N. Esha, F. T. Z. Toma, M. A. Amin, M. N. I. Khan and K. H. Maria, "Synthesis of type-II based (1-x)$Ba_{0.6}(Ca_{1/2}Sr_{1/2})_{0.4}Ti_{0.5}Fe_{0.5}O_3$+(x)$Ni_{0.40}Zn_{0.45}Cu_{0.15}Fe_{0.19}Eu_{0.1}O_4$ composites via standard solid state reaction method and investigation of multiferroic properties", AIP Advances, **8** (2018) 125207-17.

Health Physics Division, AECD

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XVI. PAPER PRESENTED IN SEMINAR/SYMPOSIUM/CONFERENCE/ WORKSHOP

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Chemistry Division, AECD

1. "Metal Concentration in Salt marsh sediments and microphytes from Bangladesh Coastal area", R. J. Rakib, M. B. Hossain, S. Akter, M. S. Rahman, K. M. Mamun and Y. N. Jolly, 39th Annual Conference of Bangladesh Chemical Society, Dhaka, Bangladesh, 17-19 October, 2018 , PP 36.
2. **"**Assessment of heavy metals in soils around Ruppur Nuclear Power Plant, Bangladesh**",** M. M. A Mollah, M. S. Rahman, Y. N. Jolly, J. Kabir, S. Akter, S. M. A. Salam and M. R. Zaman, 39th Annual Conference of Bangladesh Chemical Society, Dhaka, Bangladesh, 17-19 October, 2018, PP 121.
3. "Transfer of metals from soil to vegetables in an area near ship breaking yard, Chittagong, Bangladesh**",** M. S. Rahman, M. B. Hossain, M. Rahman, S. M. O. F. Babu, Y. N. Jolly, S. Akter[2], 39th Annual Conference of Bangladesh Chemical Society, Dhaka, Bangladesh, 17-19 October, 2018, PP 131.
4. "Metal contamination in household air dust around EPZ Industrial zone: an investigation based on multivariate statistics and spatial distribution", N. A. Kamal, S. Islam, B. A. Begum, Y. N. Jolly, S. Akter, R. Rahman, 39th Annual Conference of Bangladesh Chemical Society, Dhaka, Bangladesh, 17-19 October, 2018, PP 140.
5. "Determination of major anions and cations in water of Buriganga River**",** S. Sultana, K. J. Fatema, B. A. Begum, S. Akhter, J. Kabir, S. M. M. Rahman, J. Kabir, M. S. Rahman, K. M. Mamun and Y. N. Jolly, 39th Annual Conference of Bangladesh Chemical Society, Dhaka, Bangladesh, 17-19 October, 2018, PP 168.
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11. "Accumulation of metals in a Nectarivore and a Saprophagous insect of two areas (Curzon-Anondobazar area and Savar Hemayetpur) Around Dhaka city", A. S. Adhri, T. R. Choudhury, A. F. M. M. Rahman, H. R. Khan, M. Begum, 3rd Young Scientist Congress, National Museum of Science & Technology Bhaban, Dhaka, Bangladesh, (OP:51), 14-15 September, 2018, pp 63.
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Health Physics Division, AECD

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Materials Science Division, AECD

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90. "Physical properties of Y substituted Mg-Zn /ferrites", M. A. Ali, M. N. I. Khan, M. M. Hossain, F. U. Z. Choudhury, S. M. Hoque and M. M. Uddin, International Conference on Electronics and ICT-2018, 25-26 November, 2018, AEC, Dhaka, MS(I)-IB-06, pp. 31.
91. "Observation of electric and magnetic properties of $Ba_{0.95}La_{0.05}Ti_{1-x}Y_xO_3$", A. Ahad, A. Taher, M. K. Das, T. A. Biman, M. M. Haque, S. I. Liba, S. M. Hoque, Z. Begum, M. R. Hasan and M. N. I. Khan, International Conference on Electronics and ICT-2018, 25-26 November, 2018, AEC, Dhaka, MS(I)-IB-09, pp. 33.
92. "Investigation of physical, microstructural and magnetic properties of Sr and Al substituted $BaTiO_3$ ceramics synthesized by solid state reaction method", N. Afsana, J. U. Ahmed, M. M. Hoque, R. Rashid, A. Kumar, S. M. Hoque and M. N. I. Khan, International Conference on Electronics and ICT-2018, 25-26 November, 2018, AEC, Dhaka, PP-28, pp. 74.

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111. "Study of the structural and magnetic properties of Calcium, Strontium and Manganese substituted Barium Titanate ($BaTiO_3$)", A. Akhter, A. Anwar, A. Naher, R. Rashid, S. I. Liba and M. N. I. Khan, International Conference on Electronics and ICT-2018, 25-26 November, 2018, AEC, Dhaka, PP-27, pp 73.

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114. "Effect of Chromium substitutions on the structural, DC resistivity and dielectric properties of $Ni_{0.6}Mn_{0.2}Zn_{0.2}Cr_xFe_{2-x}O_4$ Ferrites", S. Bibi, M. N. I. Khan, T. R. Iqbal, M. M. Uddin and F. U. Z. Chowdhury, International Conference on Electronics and ICT-2018, 25-26 November, 2018, AEC, Dhaka, PP-32, pp 76.

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116. "Structural analysis with density and porosity and magnetic behavior studies of aluminium substituted Ni-An-Co Ferrites", N. Jahan, J. I. Khandaker, H. N. Das, R. Rashid and M. N. I. Khan, International Conference on Electronics and ICT-2018, 25-26 November, 2018, AEC, Dhaka, PP-35, pp 77.

117. "Structural and magnetic properties of $Ni_{0.6-x}Zn_{0.4}Sr_xFe_2O_4$", A. T. Trina, F. M. Kamal, S. C. Mazumder and M. N. I. Khan, International Conference on Electronics and ICT-2018, 25-26 November, 2018, AECD, Dhaka, PP-36, pp 78.

118. "High performance trajectory control of an electro-hydraulic actuator using brain emotional learning based intelligent controller", S. A. Nahian, R. Nasrin, R. Rashid, S. T. Mowri and K. K. Ahn, International Conference on Electronics and ICT-2018, 25-26 November, 2018, AEC, Dhaka, PP-18, pp 69.

119. Invited Talk: "Gelatin-Chitosan/Hydroxyapatite composite scaffold for bone tissue engineering", S. M. Hoque, National Conference on Physics -2019, DU, Dhaka, 07-09 February, 2019, IT-IVA, pp 62.

120. "Bone tissue engineering: synthesis and characterization of hydroxyapatite ($ca_{10}(po_4)6(oh)_2$) and development of hydroxyapatite: chitosan: gelatin based scaffold with controlled pore size", M. A. Islam, A. K. M. M. H. Meaze and S. M. Hoque, National Conference on Physics -2019, DU, Dhaka, 07-09 February, 2019, MS -01, pp 39.

121. "Effect of Lanthanum (La) doping on the structural and magnetic properties of Cu-Zn ferrite", K. Nahar, P. Roy, M. A. Hossain, M. N. I. Khan and S. S. Sikder, National Conference on Physics -2019, DU, Dhaka, 07-09 February, 2019, MS -06, pp 42.

122. "Development of chitosan coated magnetism cobalt ferrite nanoparticles for cancer thermotherapy and MRI contrast agent", A. Islam, S. M. Hoque, A. Nahar, S. I. Liba and I. M. Syed, National Conference on Physics -2019, DU, Dhaka, 07-09 February, 2019, NM -02, pp 63.
123. "Enhancement of maximum energy product (BH)max in a Co-rich Nd-Fe-B based nanocomposite exchange spring magnets", P. C. Karmaker, S. I. Liba, M. O. Rahman, N. H. Dan, P. Nordblad and S. M. Hoque, National Conference on Physics -2019, DU, Dhaka, 07-09 February, 2019, NM -03, pp 63.
124. "Study of various properties of green synthesized Cu, Ag and Cu-Ag bimetallic nanoparticles", M. M. Hasan, M. M. Rahman, M. A. Mamun, M. N. I. Khan and A. K. M. A. Ullah, National Conference on Physics -2019, DU, Dhaka, 07-09 February, 2019, NM -10, pp 66.
125. "Comparative study of spinel ferrite nanoensembles for their potential biomedical applications", S. M. hoque, M. K. Islam, M. M. Haque, S. Martim, D. Coman and F. Hyder, National Conference on Physics -2019, DU, Dhaka, 07-09 February, 2019, CM -02, pp 75.
126. "Effect of sintering temperature on structural, elastic, electric and magnetic properties of $Ni_{0.25}Cu_{0.13}Zn_{0.62}Fe_2O_4$ spinel ferrite", S. Nasrina, D. Rahaman, M. A. Matin, M. N. I. Khan, M. N. Hossain and A. K. M. A. Hossain, National Conference on Physics -2019, DU, Dhaka, 07-09 February, 2019, CM -02, pp 76.
127. "Synthesis of hydroxyapatite by wet chemical precipitation method and characterization of hydroxyapatite-chitosan-gelatin based bone scaffold for biomedical application", S. K. Mohonta, K. H. Maria, S. Rahman, H. N. Das, A. Mamun, A. Nahar and S. M. Hoque, National Conference on Physics -2019, DU, Dhaka, 07-09 February, 2019, CM -07, pp 78.
128. "Analysis of the Electrical Properties of $Ba_{0.7}Sr_{0.3}Ti_{1-X}Al_xO_3$ Ferroelectrics", N. Afsana, J. U. Ahamed, H. N. Das, A. Nahar, M. R. Hasan, F. M. Kamal, S. M. Hoque and M. N. I. Khan, National Conference on Physics -2019, DU, Dhaka, 07-09 February, 2019, CM -09, pp 79.
129. "Synthesis and hyperthermia measurement of Chitosan coated $Co_{1-x}Mn_xFe_2O_4$ ($0.0 \leq x \leq 1.0$) nanoparticles for biomedical application", S. Nasrin, F. U. Z. Chowdhury and S. M. Hoque, National Conference on Physics -2019, DU, Dhaka, 07-09 February, 2019, NM -14, pp 119.
130. "Synthesis of Iron-oxide (α-Fe_2O_3) nanoparticle by hydrothermal process and study the viability of Chitosan coated particle in hyperthermia for cancer treatment", N. Deb, I. M. Syed and S. M. Hoque, National Conference on Physics -2019, DU, Dhaka, 07-09 February, 2019, NM -15, pp 120.
131. "Green synthesis of size-controlled nanoparticles with surface modification and its effect on magnetic property", S. M. Rayhan, M. M. Rahman, M. N. I. Khan and A. K. M. A. Ullah, National Conference on Physics -2019, DU, Dhaka, 07-09 February, 2019, NM -20, pp 122.
132. "Influence of Ni substitution on structural, morphological, dielectric, magnetic and optical properties of Cu-Zn Ferrite by double sintering Sol-Gel technique", M. S. Hossain, Y. Akter, M. Shahjahan, M. S. Bashar, M. H. A. Begum, M. M. Hossain, S. Islam, N. Khatun and M. A. Mamun, National Conference on Physics -2019, DU, Dhaka, 07-09 February, 2019, PP -06, pp 127.
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134. "Investigation of the structural and transport properties of Mn doped Co-Zn Ferrite prepared by solid state reaction method", P. Saha, S. K. Shil, P. Roy, M. N. I. Khan and S. S. Sikder, National Conference on Physics -2019, DU, Dhaka, 07-09 February, 2019, PP- 55, pp 148.
135. "Study the effect of Al^{3+} on structural, elastic electrical and magnetic properties of $Ni_{0.92}Co_{0.03}Mn_{0.05}Cu_{0.05}Fe_{1.95-x}Al_xO_4$", Z. A. Papria, M. D. Rahaman, M. N. I. Khan and A. K. M. A. Hossain, National Conference on Physics -2019, DU, Dhaka, 07-09 February, 2019, PP- 61, pp 151.
136. "Synthesis and characterization of Sn doped $CoFe_2O_4$ nanoparticles prepared by Sol-gel method", A. Kumar, M. S. I. Sarker, M. K. R. Khan, M. M. Rahman, M. M. Haque and M. Kamruzzaman, National Conference on Physics -2019, DU, Dhaka, 07-09 February, 2019, PP- 63, pp 152.

137. "An easy way to synthesis of Er doped $CoFe_2O_4$ soft ferromagnetic nanocrystalline particles", M. Islam, M. S. I. Sarker, M. K. R. Khan, A. Kumar and M. M. Haque, National Conference on Physics -2019, DU, Dhaka, 07-09 February, 2019, PP- 68, pp 154.
138. "Green synthesis of Zinc oxide and Copper oxide nanoparticles using Catharanthus roseus leaf extract and their characterization", M. S. Islam, A. K. M. A. Ullah, A. R. M. Tareq, A. K. M. F. Kibria, M. K. A. Khan and M. N. I. Khan, National Conference on Physics -2019, DU, Dhaka, 07-09 February, 2019, PP- 69, pp 154.
139. "Bryophylum pinnatum leaf extract mediated green synthesis of MnO_2 NP sand their application feasibility in generationof electricity", M. M. Haque, A. K. M A. Ullah, A. R. M. Tareq, A. K. M. F. Kibria, M. N. I. Khan and M. K. A. Khan, National Conference on Physics -2019, DU, Dhaka, 07-09 February, 2019, PP- 74, pp 156.
140. "Preparation and properties of CdS thin films deposited by Chemical Bath Deposition Technique", F. T. Z. Toma, K. M. A. Hussain, M. T. Chowdhury, T. Faruqe, J. Parvin and M. N. I. Khan, National Conference on Physics -2019, DU, Dhaka, 07-09 February, 2019, PP- 93, pp 164.
141. Invited Talk: "Two-Phase Ferromagnetic composites in Co-Zr and Co-Zr-Fe systems ontaining Anti-Phase domain imparting very high strength", Dr. Engr. S. M. Hoque, Asian Forum for Materials Testing (AFMT), The Daily Star Centre- A S Mahmud Seminar Hall, 64-65, Kazi Nazrul Islam Evenue, Dhaka, 20 February 2019,

Medical Physics Division, AECD

142. "Comparative studies of absolute dose in water phantom, solid water phantom and matrix with multicube phantom", T. Kumar, P. K. Das, R. Khatun, M. A. Rahman, M. M. Ahasan, S. Akter, M. F. Uddin, H. M. Jamil, A. N. Monika, R. A. Sharmin, R. Das, M. M. Rahman and S. K. Roy, National Conference on Physics -2019, DU, Dhaka, 07-09 February, 2019, pp 53.
143. "Quality Control (QC) of CT (Computed Tomography) systems installed at the Institute of Nuclear Medical Physics (INMP) by monitoring key performance", R. Das, M. M. Ahasan, H. M. Jamil, M. F. Uddin, R. Khatun, S. Akter, M. A. Rahman, R. A. Sharmin and M. Rahman, National Conference on Physics -2019, DU, Dhaka, 07-09 February, 2019, pp 105.
144. "Study of design and drawing aspect of medium energy cyclotron facilities", M. M. Rahman, M. M. Ahasan, M. J. Abedin, R. Khatun, and S. Akter, M. F. Uddin, H. M. Jamil, A. N. Monika, M. A. Rahman, R. Das and R. A. Sharmin, National Conference on Physics -2019, DU, Dhaka, 07-09 February, 2019, pp 107.
145. "Dosimetric characteristics of 6 MV linear accelerator", S. K. Roy, P. K. Das, R. Khatun, M. A. Rahman, M. M. Ahasan, S. Akter, M. F. Uddin, H. M. Jamil, A. N. Monika, R. A. Sharmin, R. Das, M. M. RAhman and T. Kumar, National National Conference on Physics -2019, DU, Dhaka, 07-09 February, 2019, pp 140.
146. "Radiation safety aspects of computed tomography system", M. F. Uddin, R. Khatun, M. M. Ahasan, S. Akter, H. M. Jamil, A. N. Monika, M. A. Rahman, R. Das, R. A. Sharmin, M. M. Rahman and M. M. Ahasan, National Conference of Society of Nuclear Medicine, Bangladesh, 22 March, 2019.

Plasma Physics Division, AECD

147. "Observation of plasma dynamics in axial and radial phase of DPF device with varying gas pressure", G. S. Rakib, L. Akter, M. R. Haque, M. A. Malek, M. K. Islam and K. A. Kabir, International Conference on Innovation in Engineering and Technology 2018 (ICIET-2018), 27-28 December, 2018, DU, Bangladesh.
148. "Study of axial and radial phase plasma dynamics as a function of the variation of gas using Lee Model Code", G. S. Rakib, L. Akter, M. R. Haque, M. A. Malek, M. K. Islam and M. M. H. Prodhan, International Conference on Innovation in Engineering and Technology 2018 (ICIET-2018), 27-28 December, 2018, DU, Bangladesh.
149. "Fitting procedure of dpf devise in LEE Model Code", M. R. Haque, M. K. Islam, M. M. H. Prodhan, M. A. Malek and M. S. S. Chowdhuri, National Conference on Physics -2019, DU, Dhaka, 07-09 February, 2019.

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150. "Good practices for the operation and maintenance of BAEC TRIGA Research Reactors", M. A. M. Soner, IAEA Technical meeting at Vienna, Austria, 15-19 October, 2018.
151. "Management and safe decommissioning planning of the BAEC TRIGA Research Reactor", M. A. Malek, Annual Meeting of the International Decommissioning Network, Marcoule, France, 25-26 October 2018.
152. "Application of TRIGLAV code to the BAEC TRIGA Research Reactor", M. M. Rahman, National Conference on Physics -2019, DU, Dhaka, 07-09 February, 2019.

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Nuclear Radiation and Chemistry Division, INST

153. "Application of Amidoxime adsorbent for removal of methyl orange from aqueous solution", N. Rahman, N. C. Dafader and S. Shahnaz, Conference of Bangladesh Chemical Congress, Department of Chemistry, DU, Dhaka, 17-19 October, 2018, pp 71.
154. "Adsorption of Lead(II) & Copper(II) Ions from waste water using biodegradable acrylic acid-chitosan hydrogel for environmental purification", M. M. Marjub, F. S. Tuhen and N. Rahman, Conference of Bangladesh Chemical Congress, Department of Chemistry, DU, Dhaka, 17-19 October, 2018, pp 29.
155. "Trace element analysis in herbal medicines available in Bangladesh", F. T. Ahmed, M. F. Alam, A. K. M. Mahmudullah, M. S. Islam, M. H. Islam and N. C. Dafader, Conference of Bangladesh Chemical Congress, Department of Chemistry, DU, Dhaka, 17-19 October, 2018, OPA5, pp 25.
156. "Water quality monitoring of multipurpose TRIGA MARK-II Reactor, Dhaka, Bangladesh", M. F. Alam, F. T. Ahmed, S. Shahnaz, N. C. Dafader, R. Hasan, M. A. Sonar and M. A. Salam, Conference of Bangladesh Chemical Congress, Department of Chemistry, DU, Dhaka, 17-19 October, 2018, PP-062, pp 120.
157. "Application of acrylic acid and Sodium Styrene Sulfonate Grafted Non-Woven PE Febric in Methylene blue removal", N. Rahman, N. C. Dafader, S. Sultana and S. Shahnaz, National Conference on Physics -2019, DU, Dhaka, 07-09 February, 2019, pp 46.

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158. "Assessment of element distribution in the sand of St. Martin Island, Bangladesh by instrumental neutron activation analysis", K. M. N. Alam, A. A. Amin, R. khan, S. Saha, M. A. Hayder, M. M. Karim, A. H. M. Saadat, K. Naher, M. A. Islam and S. M. Hossain, National Conference on Physics -2019, DU, Dhaka, 07-09 February, 2019, ES-03, pp 46.
159. "Radiation attenuation property analysis of X-rays (65-164 kev) for natural composite materials based on Cox's Bazar Beach Sand-Minerals and Sticky Clay", M. M. Rahman, M. Shamsuzzaman, M. Rajib, R. khan, M. S. Rahman, M. M. Rahman, D. Paul and S. H. Firoz, National Conference on Physics -2019, DU, Dhaka, 07-09 February, 2019, ES-09, pp 49.
160. "Dosimetric assessment of output consistence for some newly installed Co-60 units in Bangladesh for precise radiotherapy of cancer patients", M. Shamsuzzaman, T. Siddiqua, M. M. H Bhuiyan and M. S. Rahman, National Conference on Physics -2019, DU, Dhaka, 07-09 February, 2019, HP-05, pp 53, 54.
161. "Measurement of entrance surface dose and effective dose of patients in diagnostic radiotherapy", S. S. Rubai, M. S. Rahman, S. Purohit, M. K. A. Patwary and A. K. M. M. H. Meaze, National Conference on Physics -2019, DU, Dhaka, 07-09 February, 2019, HP-08, pp 55.
162. "Monte Carlo based beam quality correction factors for photon dosimetrywith cylindrical ionization chambers", N. M. Rasel, M. S. Rahman, A. K. M. M. H. Meaze, M. Shamsuzzaman and T. Siddiqua, National Conference on Physics -2019, DU, Dhaka, 07-09 February, 2019, HP-09, pp 55.
163. "Radioactivity in local bakery products available in Chattogram, Bangladesh and assessment of annual ingestion doses to the public", U. Das, M. A. Hayder, M. L. Ali, M. I. Ali, D. Paul and A. K. Deb, National Conference on Physics -2019, DU, Dhaka, 07-09 February, 2019, RHP-01, pp 68.

164. "Assessment and characterization of shieliding properties of heavy mineral reinforced polymer composite material for radiation shieliding protection", M. M. Haque, M. Shamsuzzaman, Engr. M. B. Uddin, A. Z. M. Salahuddin and R. A. Khan, National Conference on Physics -2019, DU, Dhaka, 07-09 February, 2019, PP-04, pp 126.
165. "Calibration and Effective Point of Measurement (EPOM) of some ionization chambers for high energy photon beam dosimetry", N. A. Mokta, M. S. Rahman, T. Siddiqua, S. Purohit, M. K. A. Patwary and A. K. M. M. H. Meaze, National Conference on Physics -2019, DU, Dhaka, 07-09 February, 2019, PP-29, pp 137.
166. "Dosimetric measurement of ISO radiation quality for calibration of protection level ionization chambers", M. H. Masud, M. Shamsuzzaman, Dr. M. J. Dewan, M. S. Rahman and D. Paul, National Conference on Physics -2019, DU, Dhaka, 07-09 February, 2019, PP-36, pp 140.
167. "Estimation of annual ingestion doses due to intake of leafy vegetables collected from Savar, Dhaka, Bangladesh", S. Akhter, D. Paul, M. Idris Ali, M. M. H. Miah and M. A. Hayder, National Conference on Physics -2019, DU, Dhaka, 07-09 February, 2019, PP-37, pp 141.
168. "Investigation on radioactivity level in the fruits available in Bangladesh and assessment of annual ingestion doses to the Public", S. Akhter, M. A. Hayder, M. L. Ali, M. I. Ali, D. Paul and A. K. Deb, National Conference on Physics -2019, DU, Dhaka, 07-09 February, 2019, PP-40, pp 142.
169. "Radioluminescence responses of A1203:C versus doped silica optional fibre materials in real time medical dosimetry", A. K. M. M. Rahman, M. begum, H. A. A. Rashid, Z. Yusoff and D. A. Bradley, National Conference on Physics -2019, DU, Dhaka, 07-09 February, 2019, PP-43, pp 143.
170. "Assessment of response behavior of some radiation measurement devices", S. Sahab, M. Shamsuzzaman, M. M. H Bhuiyan, Dr. M. J. Dewan, M. S. Rahman and D. Paul, National Conference on Physics -2019, DU, Dhaka, 07-09 February, 2019, PP-64, pp 152-153.

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171. "An investigation of surface water quality for fish culture and irrigational purpose inside the area of Atomic Energy Research Establishment, Ganakbari, Savar, Dhaka, Bangladesh", M. A. Ahsan, M. A. Q. Bhuiyan, A. H. N. Khan, M. M. Karim and F. Islam, 39th Annual Conference of Bangladesh Chemical Society, Dhaka, Bangladesh, 17-19 October 2018, OPA-10, pp 28.
172. "Hydrochemical evaluation and salinity assessment of coastal deep aquifer of Patuakhali and Barguna districts of Bangladesh", A. H. N. Khan, M. M. Karim, M. A. Ahsan, A. Q. Bhuiyan, F. Islam and N. Ahmed 39th Annual Conference of Bangladesh Chemical Society, Dhaka, Bangladesh, 17-19 October 2018, PP-002, pp 75.
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