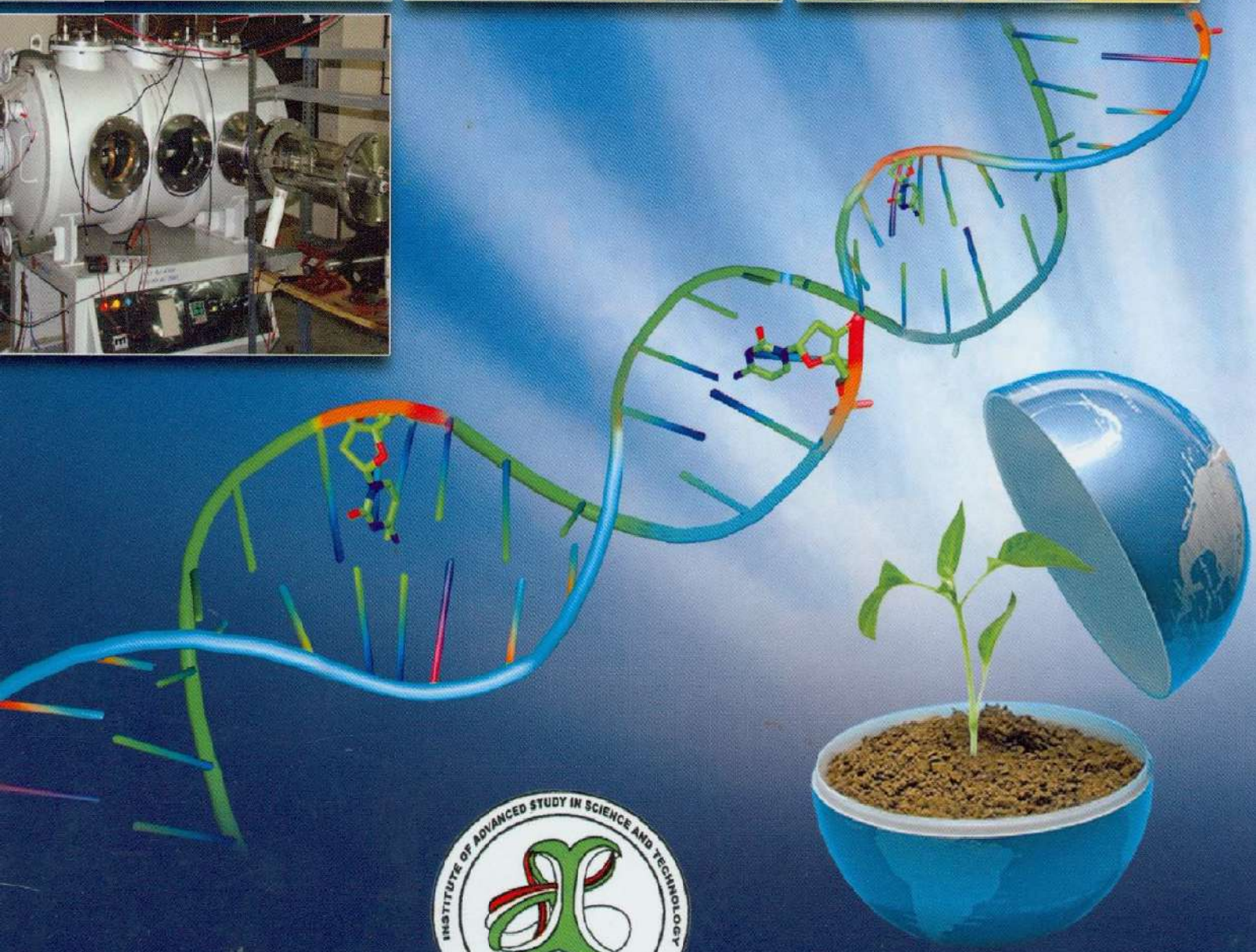
ANNUAL REPORT
2008-2009



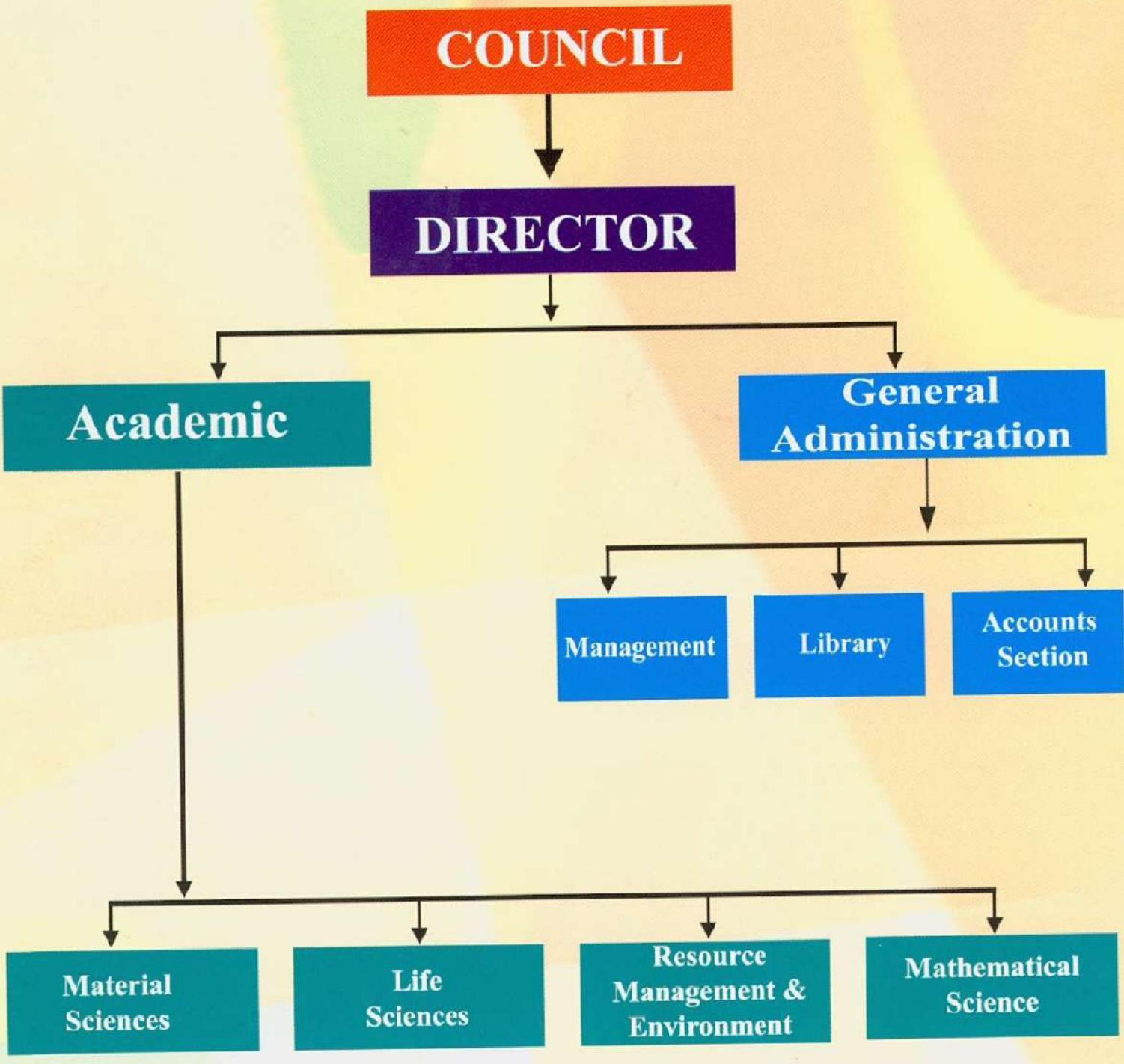
INSTITUTE OF ADVANCED STUDY IN SCIENCE AND TECHNOLOGY

GUWAHATI

1979

INSTITUTE OF ADVANCED STUDY IN SCIENCE AND TECHNOLOGY

ORGANISATIONAL SET UP



ANNUAL REPORT

2008-2009

Institute of Advanced Study in Science and Technology
Vigyan Path, Paschim Boragaon,
GUWAHATI- 781035

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Contd.....

Foreword

The most remarkable event of the year for the Institute is that the proposal for conversion of the Institute of Advanced Study in Science and Technology (IASST), Guwahati, under the Government of Assam into an autonomous grant-in-aid research institution of the Government of India (GOI) under the Department of Science and Technology (DST) has been approved by the Cabinet in the meeting held on 26/02/2009. The State Government issued the notification of Governor's approval of the proposal on 09/03/2009, from which date IASST has been declared as an autonomous Institute by the Government of India.

It is also encouraging to note that the State Government will make some contribution annually to the Institute with a view to continuing its attachment with IASST. I take this opportunity to express our warm gratitude to all the benefactors, societies, educationists and well wishers who offered their valuable advice, support and sympathized whole heartedly for the development of the Institute at every step from the very beginning.

During the period under report, IASST has been consistently carrying out research activities in some interesting areas of Physical and Life Sciences.

I am very much hopeful that IASST now will be able to pursue research work vigorously on some major fields e.g., Nanotechnology, Fuel Cell, Seri biotechnology, Bio-Chemistry, Bioremediation of soil, water, Exploration of bio-diversity etc. under different divisions. I also express my deep appreciation for the contributions of my colleagues for their relentless effort to carry out quality research work in spite of heavy financial constraints and lack of facilities.

IASST is the first of its kind of multidisciplinary research institute in the whole North Eastern Region. To achieve its goal "to build the Centre of Excellence", the Institute seeks to attract the best talents for its research and development activities. It will also inspire the young talents to attain competence of national level in the emerging and challenging areas of research.

May 4, 2009

Joyanti Chutia
Director, IASST

Council of IASST

1. Prof. K.M. Pathak Guwahati-781035	Chairman.
2. Dr. Gautam Barua Director, IIT Guwahati North Guwahati, Guwahati-781039	Member
3. Prof. Amarjyoti Choudhury Department of Physics, Tezpur University	Member
4. Prof. J.K. Datta Gupta Head of Biophysical Science Group, SINP, 1/AF, Bidhan Nagar Kolkata-700064	Member
5. Prof. H.C. Pant Emeritus Visiting Scientist Ex-Head of Laser Plasma Division CAT, Indore-452013	Member
6. Dr. Prem Saran Commissioner and Secretary Government of Assam Dept. of Science & Technology, Dispur	Member
7. Dr. Barindra Kumar Sarma President, Assam Science Society	Member
8. Prof. K.G. Bhattacharjee Dept. of Chemistry Gauhati University	Member
9. Prof. (Ms.) Joyanti Chutia Director, IASST, Guwahati-781035	Member
10. Dr. H. Bailung Registrar (i/c) IASST, Guwahati-781035	Member Secretary

VISIT OF DR. T. RAMASAMI, SECRETARY, DEPT. OF SCIENCE & TECHNOLOGY MINISTRY OF SCIENCE & TECHNOLOGY, GOVT. OF INDIA

Dr. T. Ramasami, Secretary, Department of Science & Technology, Govt. of India paid a kind visit to the Institute on 8th January 2009 on invitation. He was accompanied by Dr. B. Harigopal, Advisor, DST, Govt. of India.

In a meeting organized on the occasion of his visit at the Institutes' auditorium, Prof. Joyanti Chutia, Director, IASST offered warm welcome to them and appraised briefly about the ongoing research activities and future plan and programmes of the Institute. She also expressed her gratitude for their kind initiative in taking over the Institute by the Ministry of Science & Technology, Govt. of India, which had been reflected in the Address of the Honourable Prime Minister of India in the 96th Session of Indian Science Congress, held at NEHU, Shillong from 3-7th January 2009.

Dr. Ramasami delivered a lecture in the meeting of the faculty members, Research Scholars, employees of the Institute and expressed his satisfaction for the progress and development of the Research activities taken up by the faculties of the Institute. Dr. Ramasami expressed his commitment in extending full support in completing the formalities of taking over the Institute by his Department.

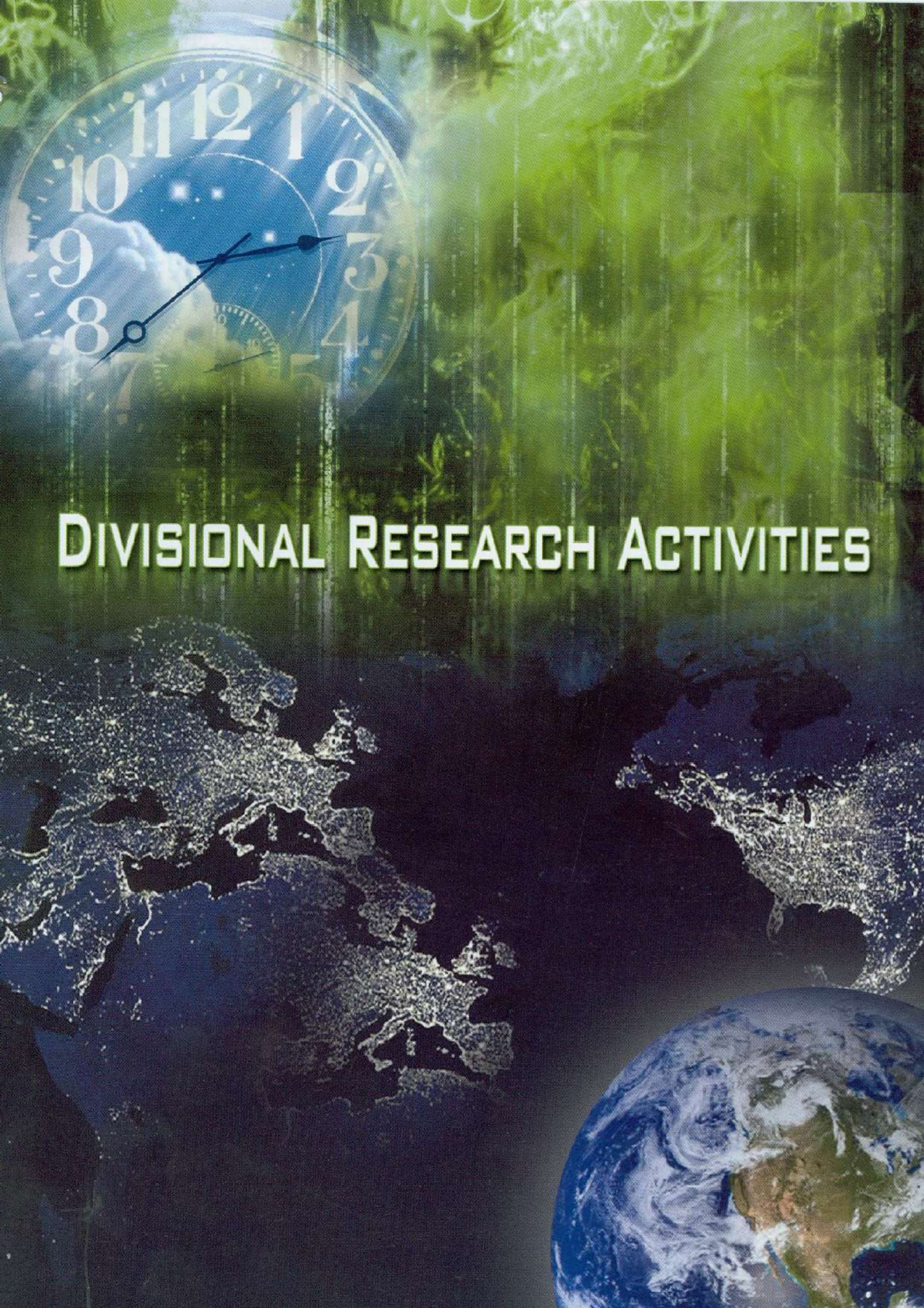
He emphasized on quality research than the quantity in basic as well as applied sciences especially on the exploration of bio-resources of the region. He invited the local young talents to take up science as future career and urged to come forward to carry out research in the emerging areas that would benefit the society. He elaborated the steps taken up by the Ministry of S & T, Govt. of India to lure the talented students towards basic research.

The secretary also visited the laboratories and interacted with the Faculties & Research Students of each division separately.

IASST is very much grateful to the Secretary as the Ministry of Science & Technology, Govt. of India formally declared the IASST as a Grant –in – Aid autonomous Institute under the DST, Govt. of India with effect from 9th March 2009.

All the employees of the Institute felt very happy for his kind visit and the scientists were much encouraged to renew their spirit of activities.

Dr. T. Ramasami Interacting with the Faculty Mambers at Laboratory


DIVISIONAL RESEARCH ACTIVITIES

A. Material Sciences Division

The Materials Sciences Division of IASST has been engaged in research in two frontier areas namely Plasma Science and Technology and Polymer Science.

A.1.ResearchActivities

A.1.1. Plasma Physics

The Plasma Physics group of the Materials Sciences Division has been engaged in few thrust areas of basic plasma research and industrial application oriented research. In the basic plasma unit research work on production of dusty plasma and measurement of average charge on dust grain have been successfully carried out. The dust ion-acoustic waves in presence of additional negative ion species show some interesting characteristics that have been observed for the first time. Propagation of ion acoustic waves in multicomponent plasma with negative ions and their interaction with ion beam have also been investigated. A magnetic filter have been designed and tested for production low density and low temperature plasma. The plasma produced shall be used for production of electron free (negative ion-positive ion) plasma and for possible lower earth orbit simulation. In plasma processing, high quality polystyrene and SiOx films have been deposited for corrosion resistant and decorative coating using RF plasma polymerization. Synthesis of conducting polymers by plasma polymerization in pulsed dc plasma has been initiated.

Basic Plasma Research

Study of dust ion acoustic wave in dusty plasma with negative ions:

The ion acoustic waves (IAW) are the electrostatic ion waves in the plasma that are driven by electrons while the ions provide the inertia. The name acoustic derives from their similarity with the sound wave propagation in gas. 'Soliton' is a special type of solitary waves which preserve their shape and speed after interactions. It arises because of the balance between the effects of nonlinearity and dispersion with a negligible amount of dissipation. In usual plasma ion acoustic compressive solitons can easily be evolved when the nonlinear effect is balanced by the dispersive effect. On the contrary, the rarefactive waves in usual plasma do not evolve as a stable structure. But, in multi-component plasma containing negative ions rarefactive waves can also be excited. The small but finite amplitude solitary waves are governed by a Korteweg-de-Vries (K-dV) type equation, while the shock waves are described by the K-dV-Burgers type equaton. The characteristics of ion acoustic solitary wave such as the velocity, height and width are agreed well with K-dV equations.

In dusty double plasma device characteristics of rarefactive ion acoustic solitary wave propagation in dusty plasma containing negative ion has been observed experimentally. It is found that, in the present dusty plasma condition, applied rarefactive (negative) voltage pulse can not breaks into rarefactive solitons until a sufficient concentration of negative ions are introduced into the dust plasma. The velocity of rarefactive solitary wave in multi-component plasma with negative ion is greater than that in presence of negatively charged dust. The velocity and width of the solitary waves are measured and compared with numerical results of the Korteweg–de Vries Burgers equation.

Theory

The modified K-dV Burgers equation describing the nonlinear propagation of the DIA wave in a dusty plasma environment in presence of negative ions can be written as

$$\frac{\partial\phi}{\partial\tau}+\frac{\nu}{2}\phi-\frac{\eta}{2}\frac{\partial^2\phi}{\partial\xi^2}+\frac{A}{B}\phi\frac{\partial\phi}{\partial\xi}+\frac{1}{2B}\frac{\partial^3\phi}{\partial\xi^3}=0 \qquad \text{---------- (1)}$$

Where,

$$A=\frac{1}{2}\left[3\alpha_2^3\frac{\left(V_0^2+\beta\sigma\right)}{\beta}+\left(V_0^2+\sigma\right)3\alpha_1^3\mu_i-\left(\mu_i-\mu_d-1\right)\right]$$

$$B=\frac{V_0\left(\alpha_2^2+\beta\alpha_1^2\mu_i\right)}{\beta}$$

$$V_0^2=\frac{\left[3\sigma(\beta+1)(\mu_i-\mu_d-1)+(\beta+\mu_i)\right]}{2(\mu_i-\mu_d-1)}$$

$$\pm\frac{1}{2}\sqrt{\left(\frac{\left[3\sigma(\beta+1)(\mu_i-\mu_d-1)+(\beta+\mu_i)\right]}{(\mu_i-\mu_d-1)}\right)^2-\frac{12\beta\sigma\left[3\sigma(\mu_i-\mu_d-1)+(1+\mu_i)\right]}{(\mu_i-\mu_d-1)}}$$

with, $\alpha_1=\frac{1}{\left(V_0^2-3\sigma\right)}$, $\alpha_2=\frac{\beta}{\left(3\beta\sigma-V_0^2\right)}$, $\mu_i=\frac{n_p}{n_n}$,

$$\mu_d = \frac{Z_d n_d}{n_n}, \quad \nu = \frac{\nu_{id}}{\omega_{pi}}, \quad \sigma = \frac{T_i}{T_e}, \quad \eta = \frac{\mu_{id}}{\lambda_D^2 \omega_{pi}}$$

and $\beta = \frac{m_p}{m_n}$

where $\xi = \varepsilon^{1/2}\left(\frac{x}{\lambda_D} - V_0 \omega_{pi} t\right)$ and $\tau = \varepsilon^{3/2}\omega_{pi} t$

are the stretched coordinates with $\lambda_D = \left(\frac{k_B T_e}{4\pi n_p e^2}\right)^{1/2}$

as the Debye length and ε as small dimensionless parameter measuring the weakness of the dispersion.

$\omega_{pi} = \left(\frac{4\pi n_p e^2}{m_p}\right)^{1/2}$ is the ion plasma frequency

μ_{id} – kinematic viscosity of the dusty plasma; V_{id} - the ion-dust collision frequency

k_B – is the Boltzmann's constant and e is the charge of an electron.

x and t are the space and time coordinates respectively

V_0 – normalized phase velocity

n_p – positive ion density;

n_n – negative ion density;

n_e – electron density

m_p – singly charged positive ion mass;

m_n – singly charged negative ion mass

Z_d – number of electrons residing on the dust grain

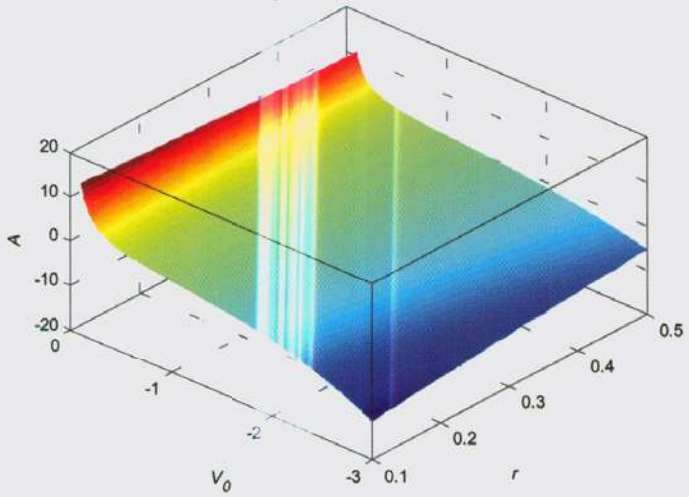
Z_n – number of electrons residing on the negative ion (= 1 in present case)

n_d – dust density;

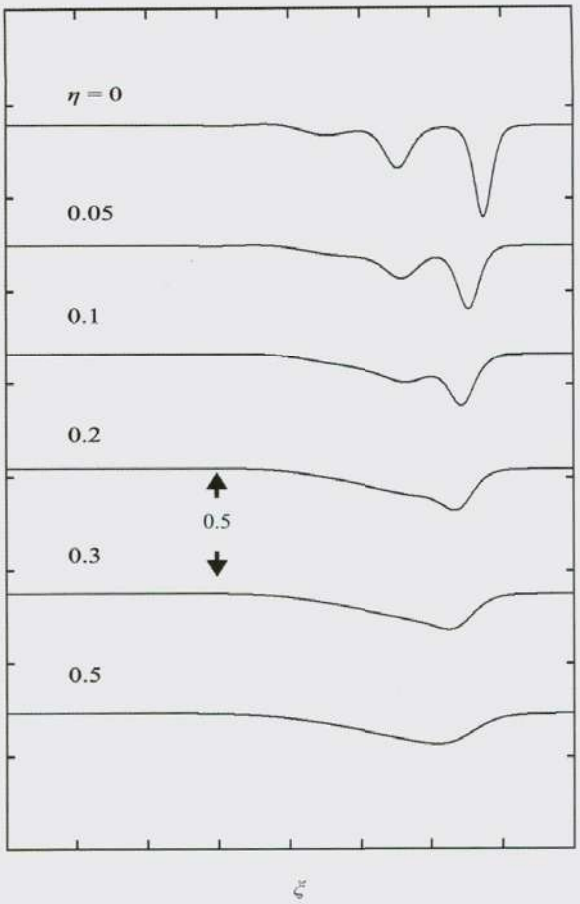
T_e – electron temperature;

T_i – ion temperature

$\phi = \delta n_e / n_e$, is the normalised DIA wave potential, where δn_e is the perturbed part of the electron density n_e



Variation of nonlinear coefficient A with normalized phase velocity V_0 and concentration of the negative ion density ratio ($r = 1/\mu_i$).

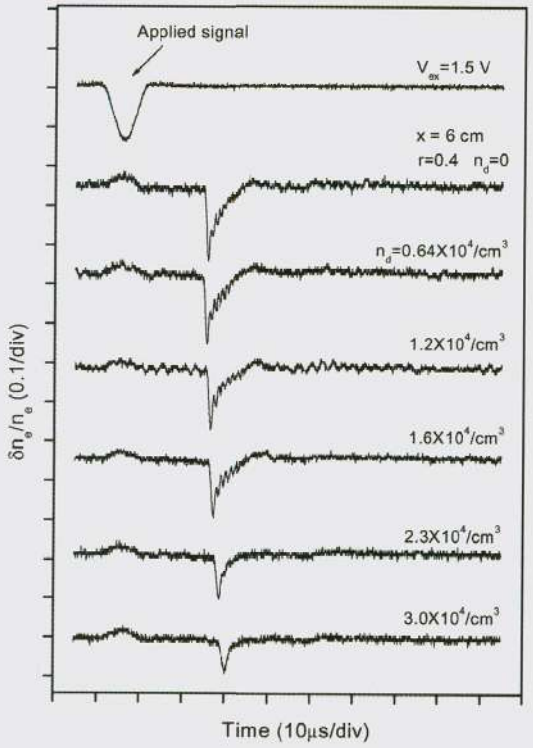


Numerical integration of Eq. (1) showing development of rarefactive solitary wave for an initial sinusoidal negative pulse having height 0.4 for different values of η at τ = 400 with r = 0.3 and ν = 0.01.

The variation of A (coefficient of nonlinear term) as a function with normalized phase velocity V_0 and concentration of the negative ion density ratio ($r = 1/\mu_i$) is shown . The numerical integrations of the Eq.(1) are shown in the figure for different values of η (Burger's dissipation term) for a constant value of ν. Increase of η physically corresponds to the increase in the dust density, which implies the increase in the ion-dust collision frequency thereby increasing the damping. It is found that the height of the solitary wave decreases as η increases and at much higher value of η ≥ 0.5 the steepening of the pulse disappears.

The observation of the ion acoustic wave propagation in the dusty plasma containing negative ion is done in a dusty double plasma device. Rarefactive ion acoustic solitary wave is first excited in the multi-component plasma with negative ions and then the affect of dust on its propagation is observed. Figure shows the evaluation of the rarefactive ion acoustic solitary wave in dusty plasma containing different dust density in presence of negative ion. The velocity and width of the solitary waves are measured as a function of wave amplitude from the temporal evolution of wave using the Langmuir probe and

compared with numerical results of the K-dV-Burgers equation and found well agreed with the theoretical prediction. It is found that Presence of dust introduces damping of ion acoustic wave and thereby modifies the balance between dispersion and nonlinearity.

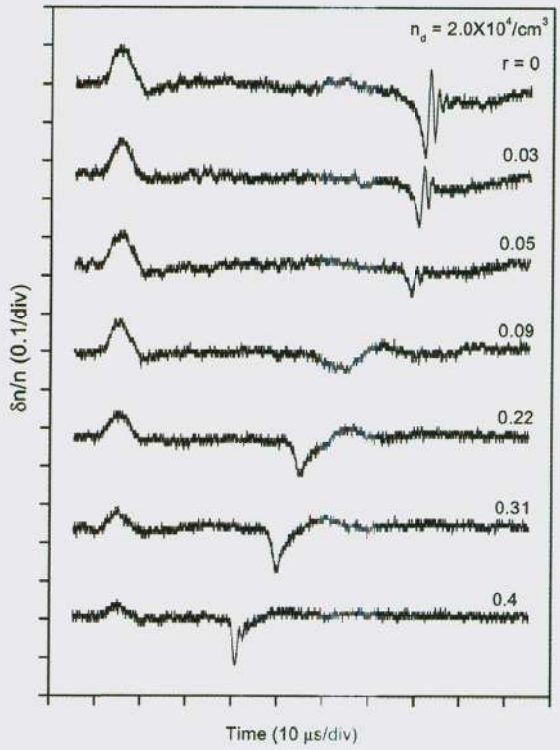


Electron density perturbation as a function of dust density nd observed at 6 cm from the separation grid. Negative ion density ratio "r" is fixed at 0.4. Top trace is the applied signal.

We have also examined the evolution of an initial negative pulse in presence of dust grains in Ar plasma without negative ions for entire dust density range. It is observed that an initial –ve pulse cannot break into rarefactive solitons in presence of dust only as the medium posses +ve nonlinearity and the steepening occurs on the falling part of the wave leading to formation of oscillatory train (top trace, r = 0, n_d = 2.0 ×10^4 cm^{-3} in figure). However, as the negative ion is introduced into the plasma and gradually increased its density the oscillatory train vanishes at r = 0.09 as shown in figure. As the negative ion density is increased further the rarefactive solitary wave is formed at nearly r =0.4. The observed perturbation becomes somewhat slower and amplitude is decreased when dust density is increased. But, the overall structure of the perturbation remains unaffected.

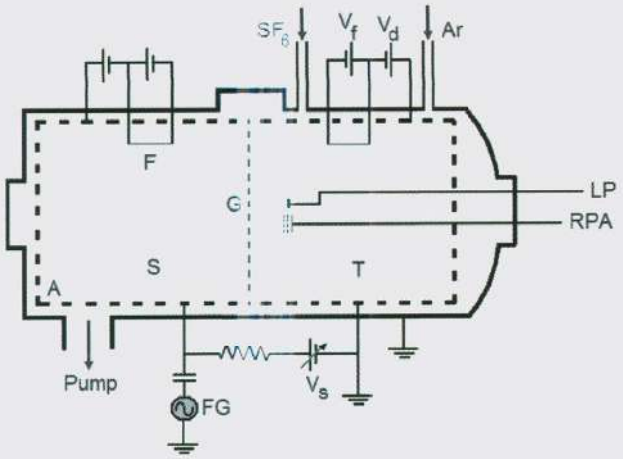
Basic experiments on multicomponent plasma with negative ions

Investigations on ion bean driven ion-acoustic wave and beam plasma interaction in negative ion plasma



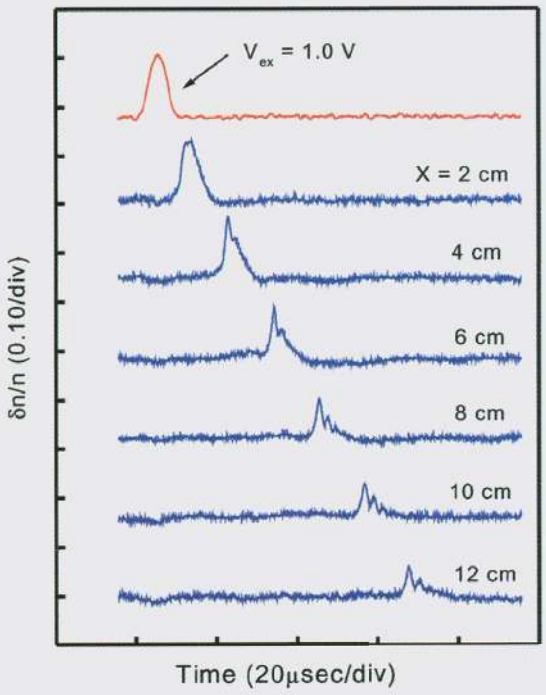
Evolution of an initial negative pulse of -1.5 V at a distance 6 cm in the presence of dust n_d=2×10^4 cm^{-3} with varying negative ion density in the plasma.

Multicomponent plasma with negative ions occure naturally in the lower ionosphere Presence of negative ions in plasmas significantly modify the charge neutrality condition, sheath, wave dispersion relation and supports new kind of wave phenomena, which do not appear in normal two component plasma. A double plasma (DP) device, 110 cm in length and 55 cm in diameter, is used to perform experiments. Schematic diagram of the experimental setup is shown in figure. Typical plasma parameters, measured with the help of Langmuir probe and retarding potential analyzer are: electron density ~10^8–10^9~cm^{-3}, electron temperature ~1-2 eV and ion temperature~ 0.1 eV. Multicomponent plasma with negative ions is produced by injecting SF6 gas into the Ar plasma. Ion acoustic perturbations are excited by applying a tone burst signal (~ 15 sec duration) to the anode of the source plasma. Transition of compressive solitons in electron – positive ion plasma, into a dispersing train of oscillations in a multicomponent plasma, when the negative ion concentration r exceeds a critical value r_c, has been observed. Characteristics of compressive ion acoustic solitons described by well known Korteweg de Vries (KdV) equation have been



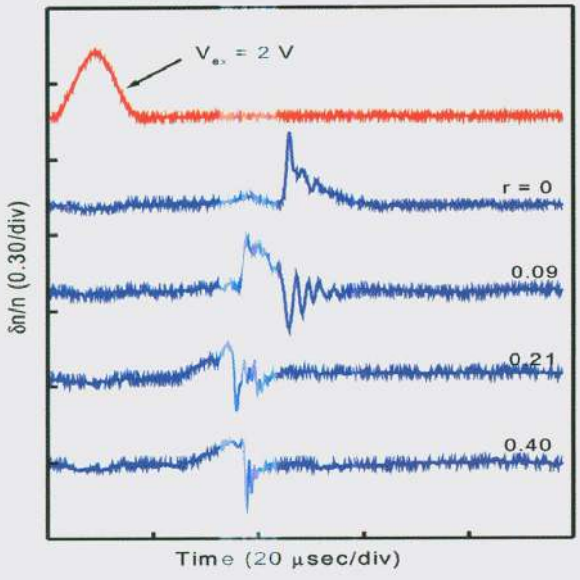
Schematic diagram of the experimental setup.
RPA: Retarding Potential Analyzer, LP : Langmuir Probe, V_f : Filament Voltage, V_d : Discharge Voltage, S : Source Plasma, T : Target Plasma, F : Filament, G : Floating Grid, A : Anode, FG : Function Generator, V_s : Source bias voltage.

verified in this device. On the other hand, an initial rarefactive perturbation initially evolves into a dispersing train of oscillations in electron – positive ion plasma and transforms into rarefactive solitons in multicomponent plasma when the negative ion concentration is higher than the critical value. The compressive solitons in the range $0 < r < r_c$ and the rarefactive solitons in the range $r > r_c$ have different characteristics than the KdV solitons at $r = 0$ and modified KdV solitons at $r = r_c$. A nonlinear differential equation having two terms to account the lower and higher order nonlinearity has been used to explain the observed results. Observation and propagation characteristics of compressive and rarefactive solitary waves at $r = r_c$, described by the modified KdV equation, and large amplitude compressive solitary waves, predicted by the pseudopotential method, have also been investigated in this device.

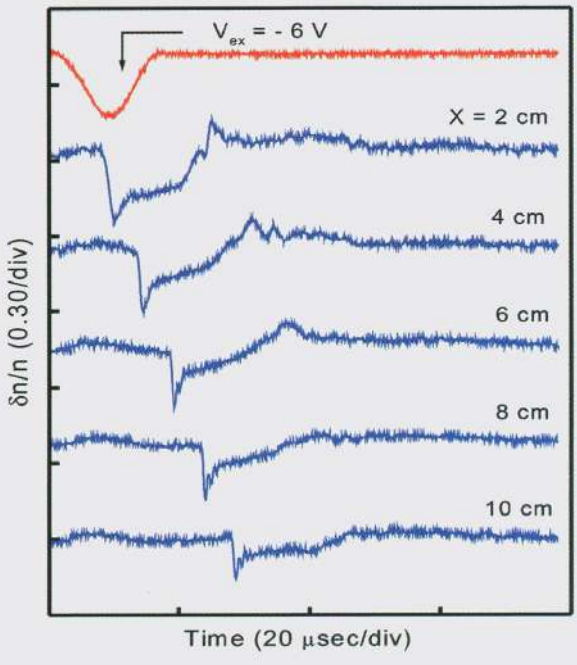


Evolution of compressive solitons in Ar plasma.

The interaction of ion beam with compressive and rarefactive solitary waves in multicomponent plasma is being studied. An argon positive ion beam is produced which flows into the target section by biasing the source plasma positively with respect to the target plasma. Wave particle (ion beam) interaction is investigated for ion acoustic wave.



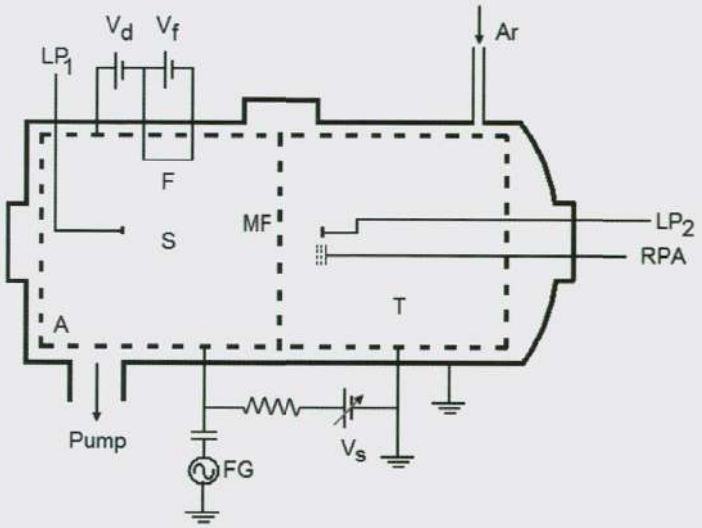
Transition of compressive solitons with r.



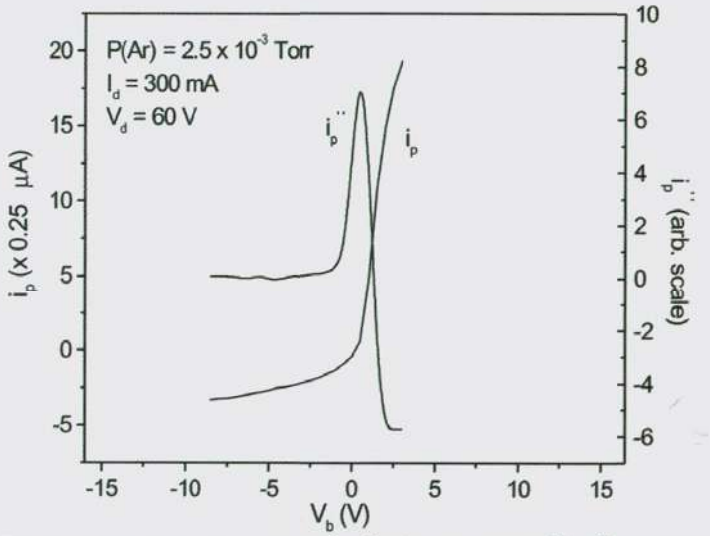
Evolution of rarefactive solitons with $r > r_c$.

Production and characteristics of low temperature and low density plasma using magnetic filter

The magnetically filtered low temperature and low density plasma is useful in production of negative ion rich plasma, simulation of D layer, plasma processing and study of sheath mechanism, beam plasma interaction, waves and instabilities. Plasma with low temperature (~0.3 eV) and low density (~10^5 cm^{-3}) electrons is produced in the DP device using magnetic filter. The magnetic filter, composed of rectangular magnetic bars placed 2.5 cm apart, allows the passage of low energy electrons and ions from the source section, where plasma is produced into the target section.

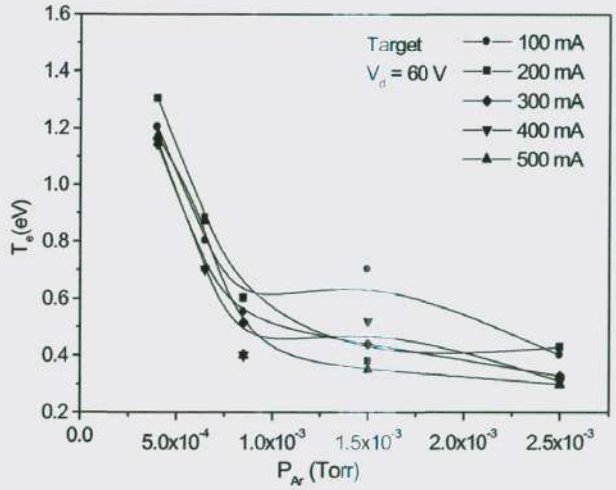


Schematic diagram of the experimental set up. S: Source, T: Target, MF : Magnetic filter, F : Filament, A: Anode, $LP_{1,2}$: Langmuir probes, RPA : Retarding potential analyzer, V_s : Source bias voltage.



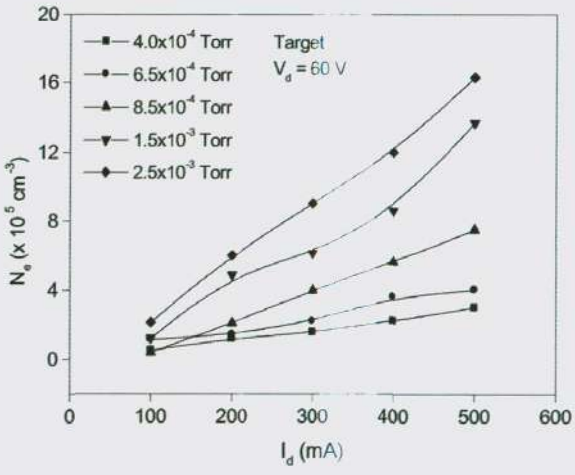
Typical I-V characteristics & electron energy distribution in target plasma.

A schematic diagram of the device with the magnetic filter is shown in Figure. Plasma parameters for different discharge current and discharge voltage at different partial pressure of Argon are measured with the help of plane Langmuir probes of 20 mm and 6 mm diameter in target and source section respectively. The magnetic filter is



Te vs Ar partial pressure

found suitable for production of low temperature plasma with T_{eS}/T_{eT} ~ 10 and low density with N_{eS}/N_{eT} ~ 10^5 (where T_{eS} and T_{eT} are electron temperature and N_{eS} and N_{eT} are electron density in source and target section respectively). Dependence of Ne and Te on various discharge parameters has been investigated. Attempts have been made to measure the sheath profile in front of a negatively biased grid using an emissive probe.



Ne vs discharge current (source).

Charging of dust grain in low density low temperature plasma:

Characterization of thermal charged particle in ionosphere is complicated by plasma sheath structures around satellite or sounding rocket payloads. It is therefore necessary to explore the charging processes

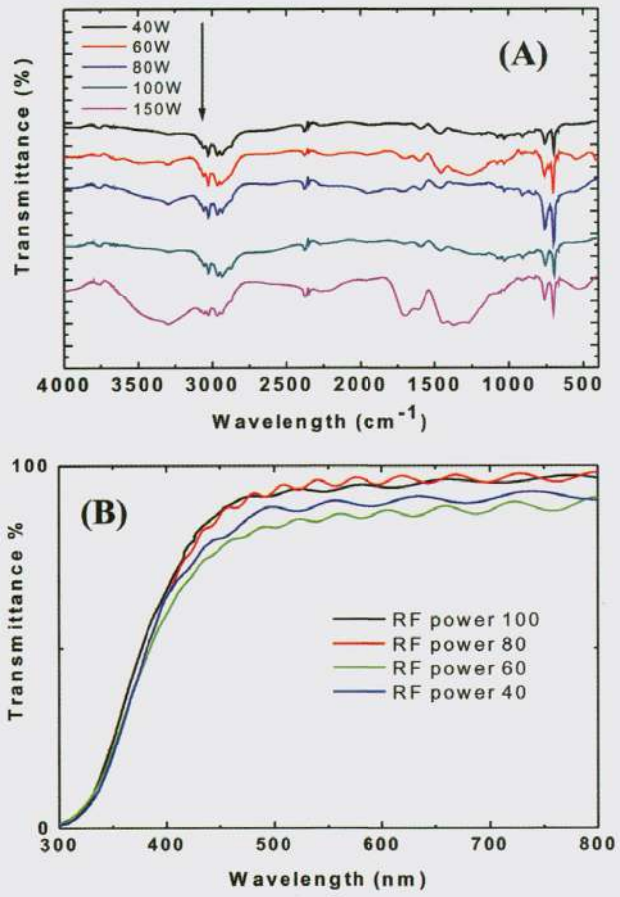
in ionospheric plasma densities and temperature. However to attain such plasma with suitable plasma parameters, the production of low temperature and low density plasma is important. Magnetic filters are most often used to control the plasma behaviour. The magnetically filtered plasma with low temperature and low density electrons is useful in production of negative ion rich plasma, simulation of D layer, plasma processing and study of sheath mechanism, beam plasma interaction, waves and instabilities. On the other hand effect of magnetic field on the charging process of dust particles in low temperature low density plasma will provide better understanding of the ionospheric processes.

The experiment is performed in a cylindrical stainless steel chamber of 30 cm diameter and 120 cm in length. The schematic diagram of the device is shown in figure. Two magnetic cages with multidipole magnet arrangement for surface plasma confinement are inserted into the chamber. The outer diameter of each magnetic cage is 40 cm and each one is made up of 20 rectangular stainless steel bars of 38 cm length, filled with permanent bar magnets of field strength ~ 1. 5 KGauss. A magnetic filter is made using permanent magnets (~1 KGauss) sealed in vacuum tight stainless steel rectangular tubes and placed 2.5 cm apart. The magnetic filter is placed in the central region of the chamber dividing the chamber into two sections Source (S) and Target (T). The base pressure of the chamber is brought down to 10^{6} Torr by using an oil diffusion pump backed by a rotary pump. Argon plasma is produced at a partial pressure of 10^{-4}~10^{-3} Torr of Argon. Discharge is made only in the source section with 5 hot tungsten filaments of 6 cm in length and 0.01 cm in diameter as cathode and magnetic cage as anode. Typical discharge parameters are: discharge voltage (Vd) ~ 60 V, discharge current (Id) 100 ~ 500 mA. The magnetic filter allows the passage of low energy electrons and ions from the source where plasma is produced. Plasma parameters such as electron density (N_e) and electron temperature (T_e) are measured with the help of plane Langmuir probes of 20 mm and 6 mm diameter in target and source section respectively. The presence of ion beam is detected with the help of a retarding potential analyzer (RPA). Typical ion temperature is $T_i \sim 0.1$ eV.

The magnetic filter is capable of producing plasma with typical values of $T_e \sim 0.2$ eV and $N_e \sim 10^5$ cm^3. Dependence of N_e and T_e on various discharge parameters has been investigated. Attempts have been made to measure the average dust charge on a single dust particle (8.8 micron glass micro-sphere) using techniques described in the previous section. Preliminary results show that average dust charge is very small (~100 electrons) and decreases with decreasing plasma density and temperature. Detailed study of dust charging in low temperature and low density plasma and effect of magnetic field on the charging process shall be taken up.

Plasma Processing

a. Radiofrequency Plasma deposition of polystyrene and SiOx-like thin films for surface modification of bell metal :

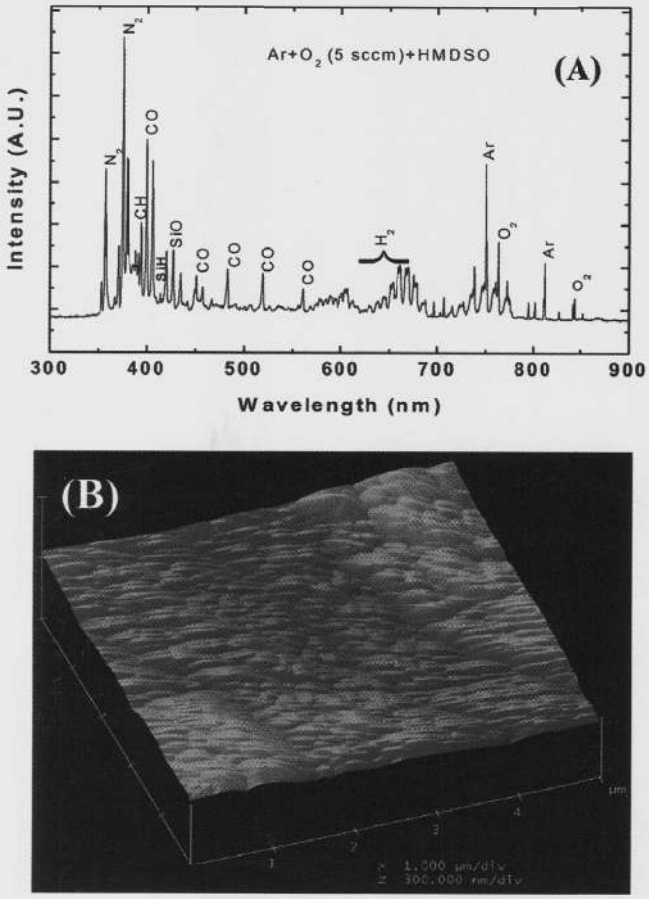


(A) FT-IR and (B) UV-Vis spectra of polystyrene films prepared at different RF powers

Deposition of polystyrene and SiOx-like films using combine radiofrequency (RF) plasma polymerization process is extensively studied for surface modification of various metallic materials. These plasma-polymerized films are highly cross-linked, adherent and chemically stable with excellent insulating and low gas permeability properties. In a recent ongoing work at IASST, studies have been made on deposition of thin coating of polystyrene (thickness ~0.9-1.5 m) and SiOx-like (thickness ~0.2-0.9 m) films on bell metal using RF plasma enhanced chemical vapor deposition

RF-PECVD) process in order to enhance its corrosion resistance behaviour. Experiments are carried out in amodified RF plasma chamber using different monomers (styrene and hexamethyldisiloxane) and gas (argon and oxygen) mixtures and under different deposition conditions. FT-IR analysis reveals that the degree of branching and cross-linking of both polystyrene and SiOx-like films increase with RF power. In case of SiOx-like films, the coatings tend to be more inorganic with increase in O_2 flow rate.

In this polymerization process, polystyrene film with very high molecular weight (M_w=1,15,11,683) has been obtained which signifies its high cross-linked density as compared to the conventional ones (Mw~50,00,000). Both polystyrene and SiOx-like films show high optical transmittance (90-98%) and insulating properties (band gap: 3-4 eV) as observed from UV-Vis spectroscopy analysis. Different active species that play important role in the film properties are investigated in-situ using optical emission spectroscopy (OES) technique during the



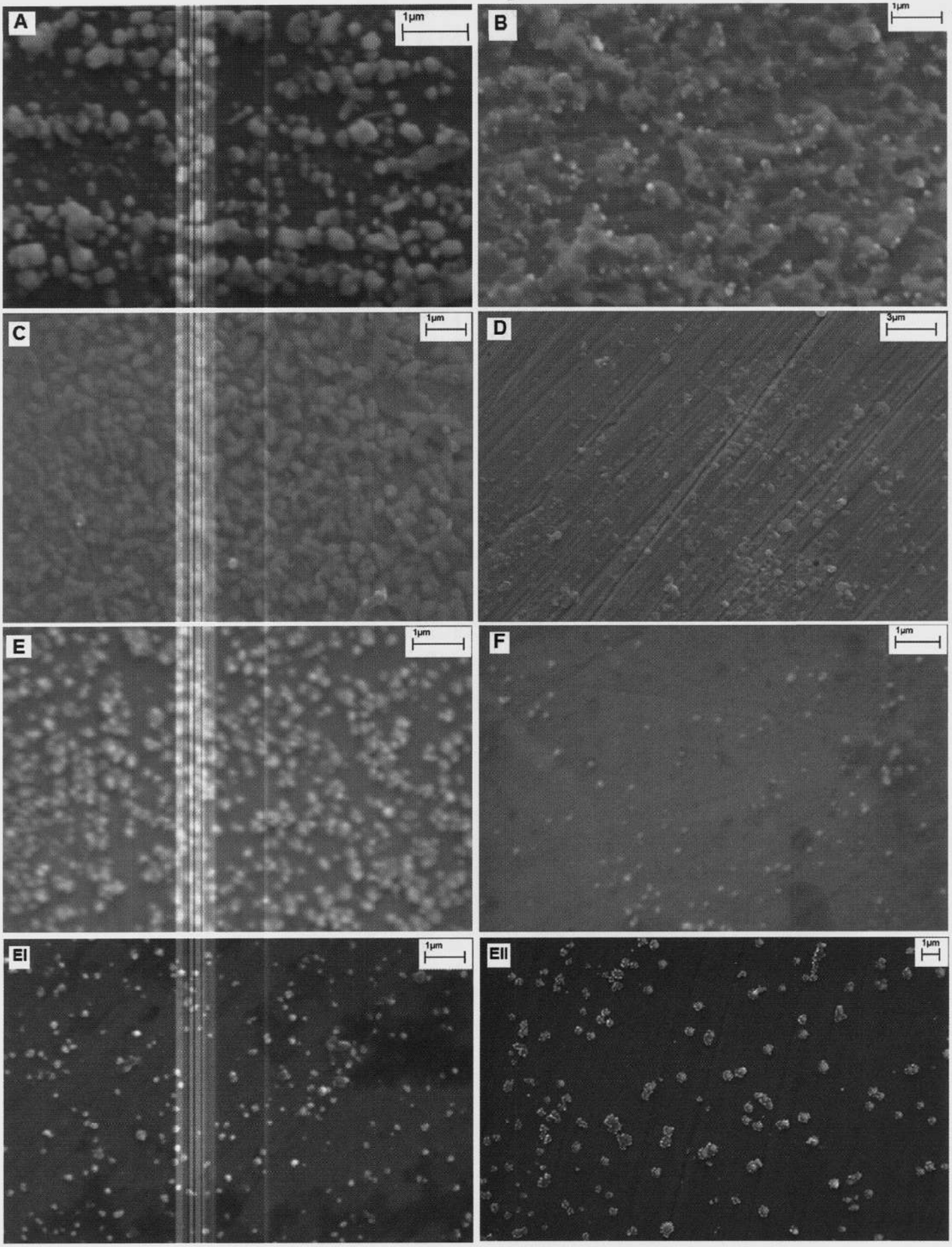
(A) OES spectra and (B) AFM micrograph of SiOx-like films prepared at RF power 106 W and working pressure 12 X 10^{-2} mbar

deposition process for each film. SEM and EDX analysis show that polystyrene films have uniform and defect free containing high percentage of carbons (85-89%). AFM micrograph shows uniform deposition of SiOx-like film with the average roughness of 16 nm prepared at RF power 106 W and working pressure 12X10^{-2} mbar From scratch test and CASS test analysis, it is seen that both films are highly adherent and exhibit good corrosion resistance behaviour under optimized deposition conditions. These results indicate that polystyrene and SiOx-like films prepared at optimized deposition condition can be considered as potential candidates to be used as corrosion resistant coatings on bell metal.

b. Nanostructured alumina deposition at low temperature on bell metal by RF magnetron sputtering:

Aluminium oxide films deposited by rf magnetron sputtering for protective coatings have been investigated. The alumina films are found to exhibit grainy surface microstructure. The grain size, structure and density depend on different system parameters such as argon and/or oxygen flow rate and applied rf power etc. The effect of transition of the discharge from metallic to reactive mode on the surface characteristics of the alumina film is studied. The films deposited under different conditions are as shown in the adjacent table.

Films A, B, C and D are deposited at oxygen flow rates of 4, 6, 8 and 10 sccm respectively and fixed argon flow rate of 12 sccm and rf power 100 W. The discharge voltage and dc self-bias decrease as the oxygen flow rate is increased. The discharge voltage decreases from 286 to 182 V while negative dc self-bias decreases from 233 to 125 V with an increase of oxygen flow rate from 4 to 10 sccm. This decrease in the values of the electrical parameters is due to gradual poisoning of the target with the increasing flow rate of oxygen as well as considerable loss of energy in the process of dissociation and ionization of oxygen molecules. The average electron temperature is also found to decrease from 5.61 to 5.22 eV with the increase of oxygen flow rate from 4 to 10 sccm. The ion flux measured with the help of the Langmuir probe is found to increase from 6.37 × 10^{22} to 9.55 ×10^{22} m^{-2} sec-1 with the increase of oxygen flow rate from 4 to 10 sccm. However the electron flux decreases from 7.325 x 10^{23} to 6.768 x 10^{23} m^{-2} sec^{-1} with the increase of oxygen flow rate from 4 to 10 sccm. The deposition rate for film A is 3.32 nm/min. The deposition rate increases in the film B up to 8.37 nm/min and decreases a little for film C (7.29 nm/min) while the film D has very low deposition rate of 1.37 nm/min.



SEM image of the aluminium oxide films

This variation can be correlated to both sputtering as well as aluminium oxide formation rate. Generally, the sputtering rate at low oxygen flow rate is high because of higher value of discharge voltage and dc self-bias and argon ion density. The deposition rate depends also on the aluminium oxide formation rate as aluminium oxide molecules have higher mass than aluminium atoms.

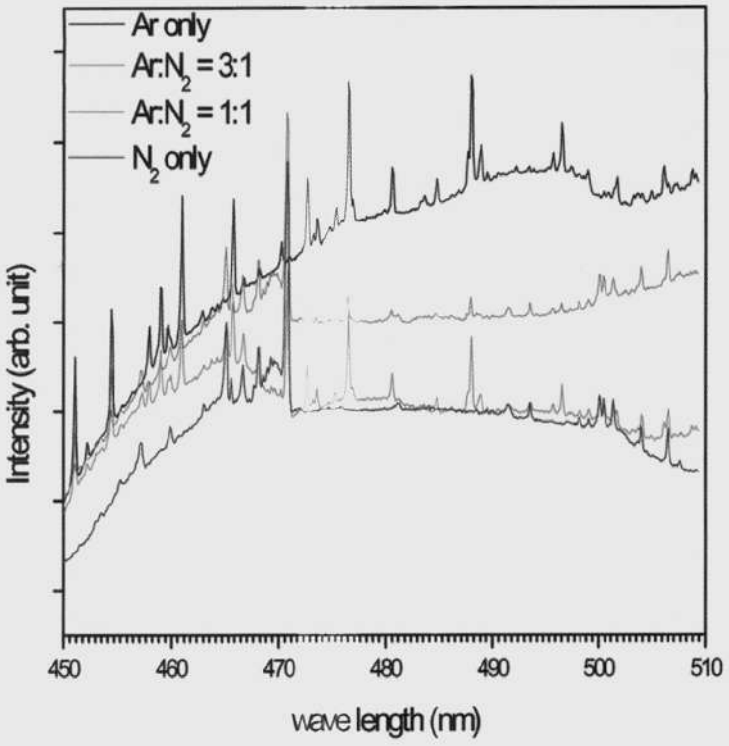
Following table shows the surface microstructures for films A, B, C, D, E, F and EI and EII. All the films exhibit grainy surface structure. Film A shows that the grain size varies from 0.4 to 0.1 micron

Film Code	Ar flow rate (sccm)	O_2 flow rate (sccm)	Pressure (torr)	RF Power (W)	r.m.s. discharge voltage (V)	DC self-bias (V)	Deposition rate ($gm/m^2.min$) x 10^{-3}	Deposition rate (nm/min)	Substrate temperature (°C)
A	12	4	1×10^{-3}	100	286	- 233	12.30	3.32	105
B	12	6	1.3×10^{-3}	100	232	- 178	31.00	8.37	100
C	12	8	1.8×10^{-3}	100	193	- 138	27.00	7.29	96
D	12	10	2.1×10^{-3}	100	182	- 125	5.10	1.37	92
E	10	6	8.2×10^{-4}	100	231	- 152	37.78	10.02	86
F	10	8	9.2×10^{-4}	100	205	- 148	31.85	8.61	84
EI	10	6	8.2×10^{-4}	125	254	- 184	42.00	11.35	99
EII	10	6	8.2×10^{-4}	150	275	- 213	45.30	12.24	120

which indicates that smaller grains agglomerate to form the bigger ones. The coalescences between the agglomerated grains or clusters can be observed in film B that is delocalized to form continuous film. Film C shows the uniform and compact distribution of grains with sizes around 0.5 micron. Film D shows less number of grain formations (i.e. low grain density). The surface defect that occurs during polishing is still visible in this film indicating very thin film deposition. The study reveals that better surface coverage of the film corresponds to deposition in the transition region. Film E also shows grainy surface structure and film F has continuous surface structure with less number of grain formations.Interestingly, the grain sizes are found to be in the range of 50 - 100 nm (nano-sized) in these films. Film EI shows the continuous film formation with less number of grains than E. It reveals that the increase of power to 125 W decreases the chance for grain formation. Film EII shows fewer grain formation than film EI but bigger in size than film EI. Thus the surface morphology of the deposited alumina films can be controlled by varying the parameters such as argon and/or oxygen flow rate and rf power.

c. Optical emission spectroscopic study in a cylindrical DC magnetron device for titanium nitride deposition:

Plasma characteristics have been studied in direct current glow discharge process in a magnetron system in argon and nitrogen reactive gas mixture environment for deposition of titanium nitride thin film coatings. Optical emission spectroscopy (OES) provides useful information on the line intensities of the different species constituting the reactive gas mixture. In discharges of argon and nitrogen gas mixture, it has been stated that atomic nitrogen species play a role in the surface nitriding processes. The presence of ionic, atomic and molecular nitrogen, as well as atomic argon and also that of the cathode species can be detected with the help of optical emission spectroscopy (OES), which is considered to be an efficient tool for plasma diagnostics. This technique is a powerful method for the 'in-situ' diagnostics of the different complex mechanisms occurring in the glow discharge process. One of the important advantages of this sensitive detection technique is that it provides high space resolution and also allows real-time information on the processes in the plasma without producing any interference with them. It is now an established fact that the numerous lines, which are optically emitted by the different species, are the result of various collisional mechanisms. Moreover, it is also argued that the relation between the intensity of the emission lines and the densities of the corresponding species is not straightforward. It is intrinsically dependent on the sputtering conditions namely pressure, current, gas flow as well as the geometry of the target. A qualitative analysis of the optical emission lines inside the plasma generating cylindrical magnetron chamber and



OES intensity versus wavelength plot for different nitrogen percentages at total gas pressure 2×10^{-3} Torr, discharge voltage 600 V and magnetic field 100 Gauss.

a comparative study of the prominent line intensities in the presence and absence of the reactive nitrogen gas inside the chamber has been done.

The emission spectra of the discharge for different ratios of Ar and N_2 obtained by using the Monochromator are shown in figure. The light from the discharge is obtained through a quartz window and taken to the Monochromator using an optical fiber. The wavelength scanning is performed for wavelength 450 nm – 510 nm. In the figure, a clear transition of spectral lines from Ar to N_2 discharge can be observed. In discharge with only Ar, many of the Ar lines appear prominently (typical lines are at 451.07 nm, 476.48 nm, 488.1 nm). Few Ti lines also appear with moderate intensity (typically at 459.9 nm, 466.8 nm, 468.2 nm, 499.1 nm).

When Ar is mixed with 50% N_2, it is seen that intensity of the Ar lines decreases and new lines (typically at 493.51 nm, 500.2 nm and 500.5 nm) and band (typically at 470.9 nm) for N_2 appear along with the Ti lines. When discharge is maintained with N_2 only, most of the Ar lines disappear and only N_2 lines and band with increased intensity along with Ti lines are seen. Line intensity is estimated by measuring the area under the curve of the lines corresponding to particular species. Table shows the prominent emission lines

Species	Wavelength, λ (nm)	Transition	Intensity (a.u.) (100% Ar)	Intensity (a.u.) (50% Ar & 50% N_2)	Intensity (a.u.) (100% N_2)
Ar	451.07	$3s^2 3p^5(^2P^0_{1/2})4s - 3s^2 3p^5(^2P^0_{3/2})5p$	0.02028	0.01334	
N^+	469.59	$2s2p^2(^4P)3p - 2s2p^2(^4P)3d$		0.000175	0.000947
Ar^+	476.48	$3s^2 3p^4(^3P)4s - 3s^2 3p^4(^3P)4p$	0.02035	0.00756	
N	493.51	$2s^2 2p^2(^3P)3s - 2s^2 2p^2(^3P)4p$		0.00101	0.00186
Ti	499.11	$3d^3(^4F)4s - 3d^3(^4F)4p$	0.00307	0.0024	0.00133

Identified spectral lines using OES at different wavelengths. Only a selection of the most prominent lines is tabled.

of different observed species along with their transition levels and relative intensity variations. Emission spectra confirm the presence of both Ti and N_2 species in the plasma. With the introduction of N_2, though the electron density slightly decreases, the density of the concerned species dominates the intensity variation of a particular line. As expected, the intensity of the Ar lines decreases whereas that of the N_2 lines increases with the increase of N_2 percentage in the gas mixture.

d. Theoretical study of Plasma sheath phenomenon in active magnetized plasma

An attempt has been made to study the theory of plasma sheath in active magnetized plasma. The analysis has been developed in cylindrical geometry using the fluid approximations to the plasma particles. The magnetic field is considered to be along the axial direction of the cylindrical cathode, which serves as the wall; while the electric field is in the radial direction of the cylinder. The effects of ionization, charge-neutral collisions in plasma have been taken into account. It has been observed that the sheath in such plasma is controlled by the strength of the applied magnetic field as well as the neutral gas pressure. Sheath potential profiles and various properties of the plasma sheath have been found out by applying different magnetic fields and gas pressures.

For the considered plasma model the dynamical equations have been obtained in non-dimensional form as

$$\frac{\partial N_i}{\partial R} = \left\{\frac{1}{(1-\alpha U_i^2)}\right\}\left[\begin{array}{l} -\alpha N_i E - \left(\frac{\omega_{ci}}{\omega_{pi}}\right)^2 (\alpha N_i R)\left(1+\frac{\nu_{in}}{\omega_{pi}}\frac{R}{U_i}\right)^{-1} \\ -\left(\frac{\alpha}{\omega_{pi}}\right)(\nu_{in}N_i + \gamma N_e)U_i + \frac{\alpha N_i U_i^2}{R} \end{array}\right]$$

$$\frac{\partial N_e}{\partial R} = N_e E - \left(1+\frac{\omega_{ce}^2}{\nu_{en}^2}\right)\left(\frac{m_e}{m_i}\right)\left(\frac{\nu_{en}}{\omega_{pi}}\right)N_e U_e$$

$$\frac{\partial N_e}{\partial R} = N_e E - \left(1+\frac{\omega_{ce}^2}{\nu_{en}^2}\right)\left(\frac{m_e}{m_i}\right)\left(\frac{\nu_{en}}{\omega_{pi}}\right)N_e U_e$$

$$\frac{\partial U_i}{\partial R} = \left(\frac{\gamma}{\omega_{pi}}\right)\left(\frac{N_e}{N_i}\right) - \frac{U_i}{N_i}\frac{\partial N_i}{\partial R} - \frac{U_i}{R}$$

$$\frac{\partial^2 V}{\partial R^2} = (N_i - N_e) - \frac{1}{R}\frac{\partial V}{\partial R}$$

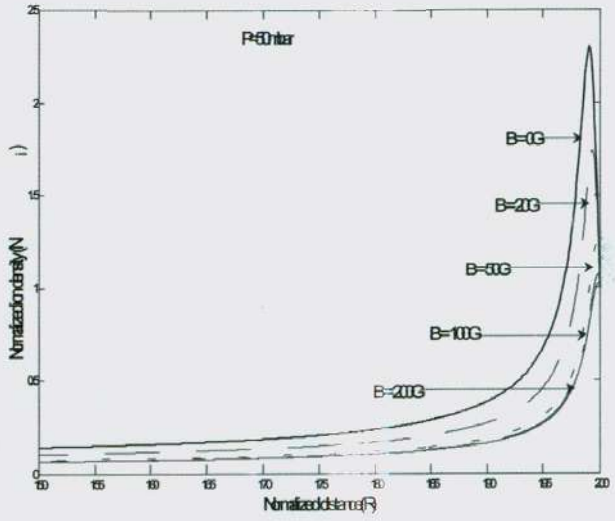
where the symbols have their usual meanings. These set of equations have been solved simultaneously to for the study of sheath characteristics in the plasma.

For numerical estimations the typical plasma parameters that have been used are: equilibrium density of plasma, $n_0 = 1.5\times10^{15}m^{-3}$, $T_e = 5eV$, $T_i = 0.05eV$.

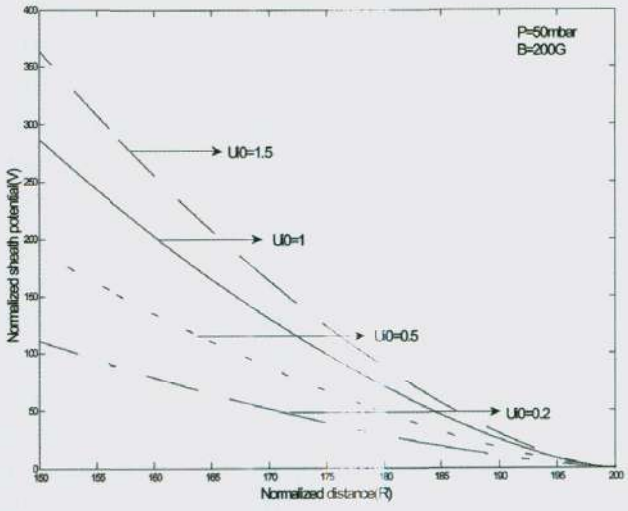
Various properties of plasma sheath have been estimated numerically by applying the magnetic field of strengths 20G, 50G, 100G and 200G and neutral gas pressures 10mbar, 50mbar and 100mbar. All these parameters are available in laboratory plasma at low pressures. The boundary values of the plasma parameters at the plasma sheath edge (R^s)

$$V \approx 0,\ \frac{\partial V}{\partial R} \approx 0,\ U_{is} = 1,\ U_{es} = \sqrt{\frac{8m_i}{\pi m_e}},\ N_{is} \approx N_{es} = N_0 = 1$$

It has been noted that, at a particular distance from the sheath edge, the value of sheath potential decreases as



Variation of normalized ion density with normalized distance at different strengths of magnetic field; *P =50mbar, n_0 = $1.5x10^{15}$ m^{-3}.*



Relative variation of normalized sheath potential with normalized distance at different initial values of normalized ion velocity; *B = 200G, P = 50mbar,* $n_{i0} = 1.5x10^{15}$ m^{-3}.

the strength of the magnetic field is increased. The transition layer is also found to be lengthened by a stronger magnetic field. It is seen that without a magnetic field, the strength of the sheath electric field becomes maximum at a fixed neutral gas pressure.

One more observation is that beyond 200G strength of the magnetic field there is no change in the potential profile of sheath provided all other conditions are kept constant. As the magnetic field becomes stronger, it is able to confine more plasma particles. The magnetic field minimizes the flux of the plasma particles towards the cathode. Therefore, a larger volume of space charge is required to shield the cathode electric potential. So the sheath dimension increases. Since, we have estimated the results at a fixed pressure of the neutral gas; at a particular strength, the magnetic field attains the maximum confinement ability to the plasma particles.

In the ion density distribution curves as shown in figure. Sharp peaks are observed near the plasma sheath edge. The creation of peak is attributed to the following two facts: (i) We have considered the ionization as a source term in the continuity equation. Because of this continuous ionization process in plasma, ion density near the plasma sheath edge will be more than the equilibrium density. In our present model, the ionization is assumed to be by the electrons only and electron density falls rapidly within a very short distance from the sheath edge. So the ionization process is mainly occurs nearer to the sheath edge. Inside the sheath there are hardly any electrons to make ionization. The peak shifts to lower value as the magnetic field becomes stronger. This is because of the fact that a strong magnetic field restricts the electrons and ions from entering into the sheath by giving them more azimuthal motion. Since electrons are highly effected by the magnetic field they cannot enter well inside the sheath to create ionization. While solving the coupled equations we used the initial density of ion as $N_{i0} = 1$. This is the normalized equilibrium density of ions. The additional density due to ionization has not been included. (ii) From the continuity equation, in the simplest case, i.e. with no source term we get $N_i U_i R = N_{i0} U_{i0} R_0$ i.e. $(N_i / N_{i0}) = (U_{i0} R_0 / U_i R)$. At a given plasma condition, N_{i0}, U_{i0} and R_0 have fixed values. The ions are accelerated by the sheath electric field. Near the plasma sheath edge, the term $(U_{i0} R_0 / U_i R) > 1$. At this situation, peak arises. As the ions move into the sheath, ion velocity increases and $U_i R$ becomes greater than $U_{i0} R_0$; and the peak disappears.

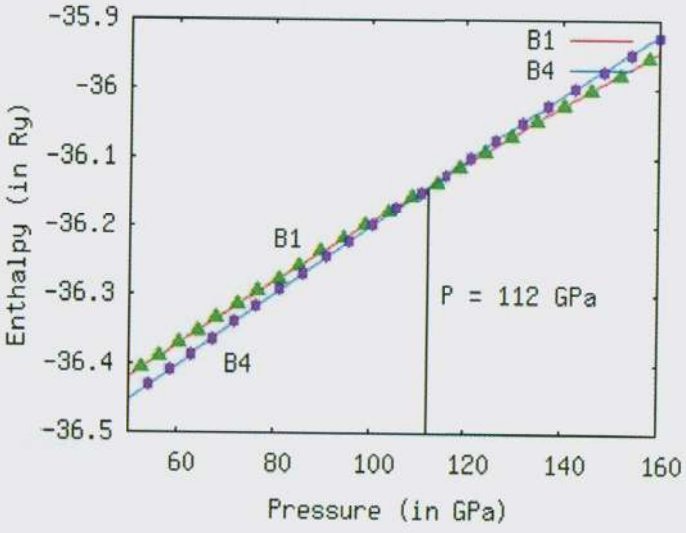
We have also estimated the electron density distributions in the sheath. It has been observed that electrons hardly enter into the sheath. Though in absence of magnetic field (B = 0) electrons can move into a short distance, they are exempted from this chance by an applied magnetic field.

It is useful to have as a check the initial drift velocity of ions into the sheath. In figure we have shown the potential structures of sheath for different initial velocities of ions. It has been observed that in the considered plasma system, plasma ions can penetrate into the sheath with velocity lower than the Bohm velocity ($U_{i0} = 1$). For $U_{i0} \leq 0.1$, the solution doesn't exist. With the increase of the drift velocity the sheath electric field becomes stronger and the sheath dimension to shield a particular electric potential becomes smaller.

Condensed Matter Physics

Ab initio calculations of vibrational and thermodynamic properties of oxides under pressure

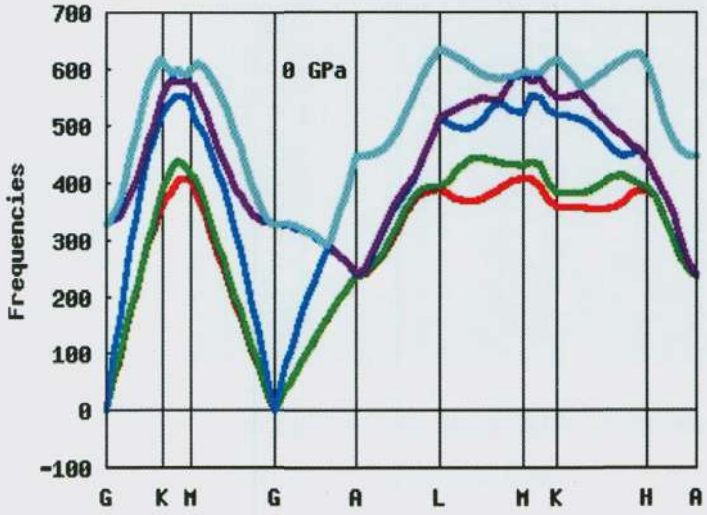
The main objective of this project is to study the vibrational and thermodynamic properties of oxides under pressure using ab initio methods based on density functional perturbation theory (DFPT). This method gives accurate and reliable informations on the lattice dynamics or the vibrational properties of a system. The system that has been studied till now in this project is beryllium oxide. Beryllium Oxide, which is a wide band gap (~10.6 eV) insulating oxide, is unique in structure as it crystallizes in the hexagonal wurtzite structure unlike the other four oxides in its group which crystallize in rocksalt structure. It has lightweight character, very high rigidity and has excellent thermal management property and hence is of particular importance in Photonics, semiconductor manufacturing, power electronics etc.

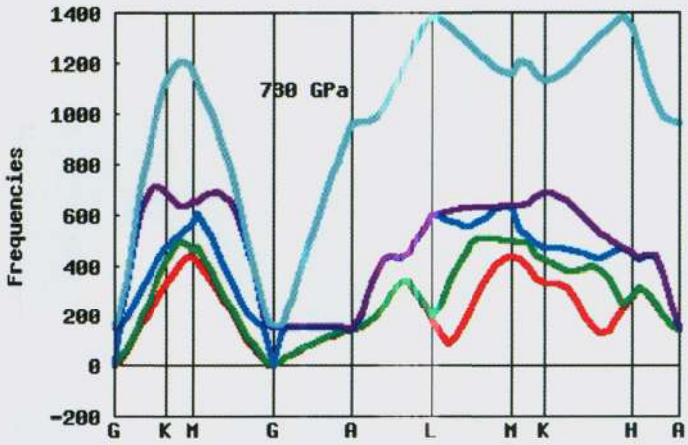


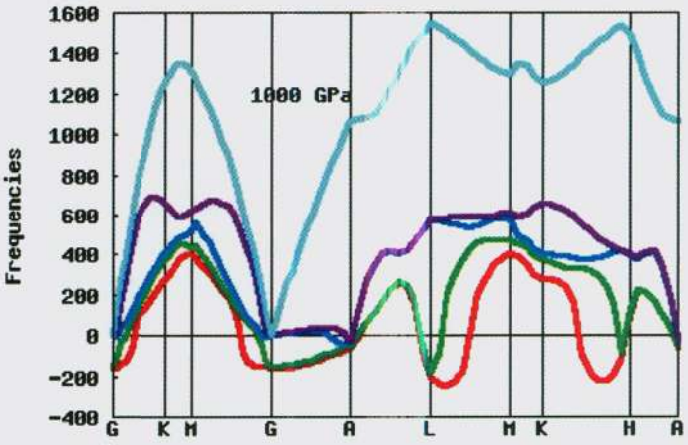
Some significant results on this particular oxide over the last one year are listed below.

The pressure induced phase transition has been studied in bulk beryllium oxide material. With the application of pressure the system undergoes a structural phase transformation from hexagonal wurtzite (B4) to cubic rocksalt(B1) structure. Figure shows the enthalpy versus pressure plots for B4 and B1 phases at 0K. The transition pressure comes out to be 112 GPa. This is in good agreement with the available theoretical and experimental results.

An attempt has been made for the first time to understand this pressure induced phase transition from lattice dynamics. The general condition for the stability of a structure in terms of lattice dynamics is that all normal modes of vibration have real and finite frequencies. To check this one has to consider the stability against three distinct types of deformations: long wavelength homogeneous deformations related to zone-center acoustic modes, long wavelength inhomogeneous deformations related to zone-center optic modes and short wavelength deformations related to all other zone boundary modes. A decrease in frequency of any of these modes means that the system is approaching the limit of dynamical stability. To look for soft phonon modes, full dispersion relations were calculated along the high symmetry directions in the first Brillouin zone at several pressures assuming BeO to exist in its B4 phase. In figure dispersion relation plots for acoustic modes and low frequency optic modes have been shown at pressures 0GPa, 730GPa and 1000GPa.







From figure we see that the phonon instability or phonon softening occurs at a pressure much higher than the transition pressure predicted by enthalpy calculations. This is typical for a first order phase transition. Phonon softening or lattice instability is not the single parameter which causes the phase transition. The softening of phonon modes are to be coupled with a one dimensional strain in order to explain the exact transition mechanism.

A.1.2. Polymer Science

Currently the Polymer Science Section has been involved in synthesizing high value polymers. During the last one year a number of polyelectrolytes, Low-density porous materials or 'foams' for laser-plasma experiments, a few polyelectrolyte complexes in nano fine state and liquid crystalline polymers were synthesized and characterized.

In polymer section, Material Nanochemistry group is working on nanomaterials of metals, semiconductors, inorganic, organic, polymer, polymer composites and hybrid materials. The aim is to develop a comprehensive chemical methodology leading to a systematic bottom-up fabrication of nanoscale

Research Scholar working with GPC.

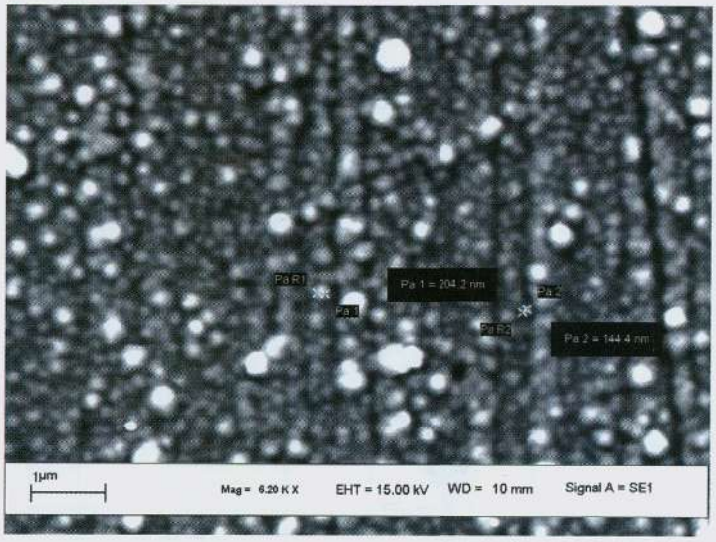
electronic devices. This will be achieved by bottom-up nanofabrication strategy enroute by planned supramolecular architecture via surface self-assembly. The protocol involves using the combination of surface self-assembly with its chemical modification and tools of nanofabrication (Constructive Nanolithography), an Atomic Force Microscope (AFM) based nanolithography technique to fabricate viable nanodevices working as transistors, biosensors and chemical sensors. The projects being undertaken in the laboratory reflects the central research theme of the laboratory. The details of work carried out in polymer section are as follows:

Synthesis, characterization and conductivity measurement of poly (2-vinyl pyridine) complex in nano fine state.

It is a known fact that poly (2-vinylpyridine)-iodide, P2VP-I_2 is used to prevent the degradation of electrode of metallic lithium in solid state batteries. Since they are discharged at low conductivity rates usually, they are suitable for implantable devices. Literature survey indicates that batteries with metallic electrodes like Li have a limited life-cycle due to the degradation of its outer surface causing the formation of lithium powder with a very high surface area at the interface between the metallic lithium and the electrolyte. The formation of the lithium powder is undesirable because it reacts violently with moisture and air affecting the cell performance. Other alternatives have been suggested to overcome such problems, but they are prone to a large loss of capacity as compared to metallic lithium. The use of lithium alloy as the alternative also of little use because it has a relatively short cycle life due to mechanical degradation of the electrode. Therefore, a cell is needed which overcomes overcomes the problems of passivity and thereby prevent the degradation of the cell.

SEM photograph of P2VP(N)

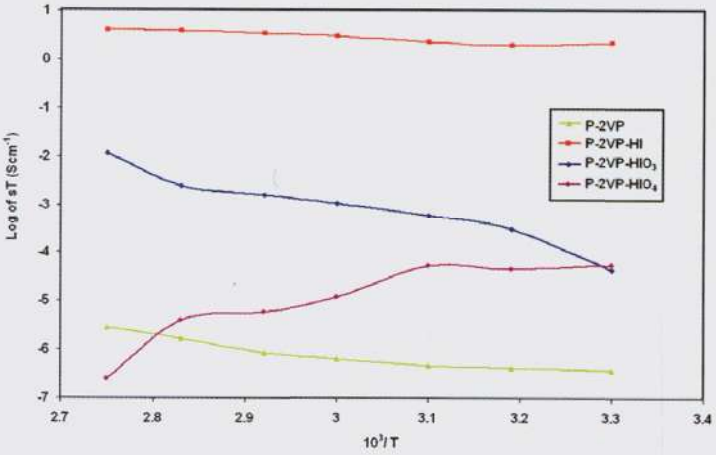
However, the conductivity of P2VP-I_2 is not very high, typically 10^{-7} Scm^{-1} at 25 °C. So it is assumed that if P2VP-I_2 can be synthesized in nano fine state, the problem may be solved. The starting material Poly (2-vinylpyridine), P-2VP must also be in nano fine state to prepare P2VP-I_2 in nano fine state. Therefore, we synthesis P2VP in nano fine state by electrolysis of P2VP-HCl salt followed by the synthesis of $P2VPI_2$ by the interaction of, P2VP with iodine in vapor state. The polymer so formed is characterized by IR, UV, SEM and conductivity studies. The final study shows that the nano material synthesized may be a potential candidate for the lithium/iodine battery.



SEM photograph of P2VP-I_2 (N)

Investigations on pyridinium salts as a solid state ionics.

Solid poly electrolytes are gaining importance as ionics in solid-state electrochemistry due to their potential value in high energy density batteries. The main advantage of polymereric electrolytes are their mechanical properties, ease of fabrication of thin films of desired sizes and their ability to form proper electrode-electrolyte contact. The first solvent-free electrolytes to have been reported are the poly (ethylene oxide) PEO-based complexes with alkali metal salts. One of the important classes of polymer electrolytes is polymer-salt complexes in which some polar polymers like poly (ethylene oxide), polypropylene oxide, polyvinyl alcohol etc. are doped with alkali-metal salts or metal salts or acids.



Conductivity data of polyelectrolytes

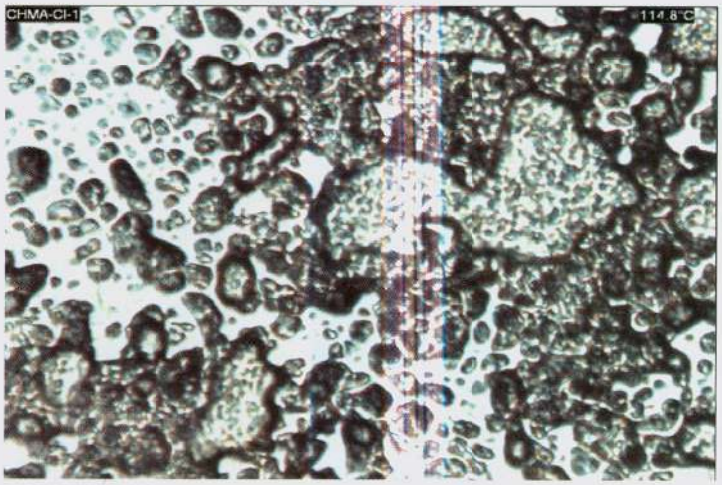
The aim of this work is to synthesize and study the conductivity of some salts of poly-2-vinyl pyridine with acids of iodine. The beauty of this system is that unlike most of the well-known polymer electrolytes based PEO, complexed with alkali metal salts, no external salt is used to impart ionic character.

Conductivity data for P-2VP, P-2VP-HI, P-2VP-HIO_3 and P-2VP-HIO_4 with respect to temperature showed that the P-2VP-HIO_3 and P-2VP-HIO_4 salt needs higher activation energy. The mechanism of conduction for the polymeric material is a mixture of ionic and electronic. The activation energy computed from Arrhenius plot of Log (T) vs 1/T of the compounds P-2VP, P-2VP-HI, P-2VP-HIO_3 and P-2VP-HIO_4 are 0.292, 0.069, 0.854 and 0.879 eV respectively. Out of these four materials P-2VP-HI shows least amount of activation energy indicating the ease of ion formation. Therefore, it is obvious that P-2VP-HI shows good polyelectrolyte quality. There was about $5X10^6$ time increase of conductivity in the case of P-2VP-HI and around $1X10^2$ times for P-2VP-HIO_3 with respect to P-2VP. From the study it is concluded that P-2VP shows mixed ionic and electronic conduction. Formation of the salts increases the ionic conduction of both P-2VP-HI and P-2VP-HIO_3 and P-2VP-HI shows marked increase in conductivity. P-2VP-HI behaves an intrinsic conducting polymer (ICF) and therefore it is a potential candidate for use in solid-state batteries.

Study of Carbon foams:

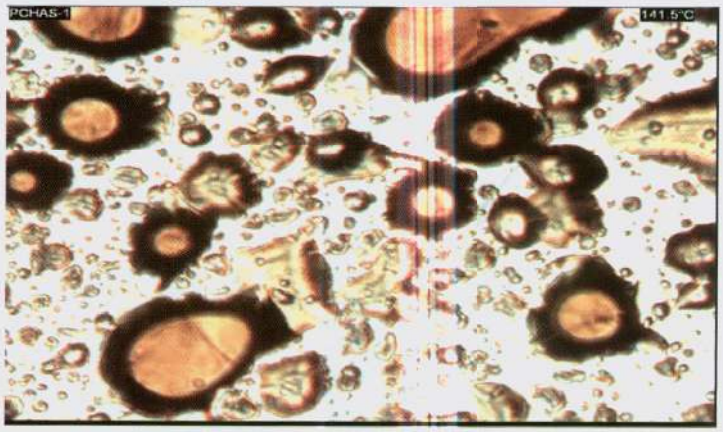
Carbon Aerogels are unique material for fusion target coating. We have made carbon foams with definite density (1.0 gm/cc). Carbon gels are deposited on glass and other metal substrate. The material was sent to Prof. D. Batani of Milan University, Italy to test the efficiency as fusion target coating.

Synthesis and characterization of cholesteryl acrylate, methacrylate and 4-pentenoate and their study as liquid crystalline polymer.



Cholesteryl Methacrylate polysulfone at 114.8^0 C.

Three liquid crystalline polymers and its sulfone were synthesized in polymer laboratory and show some good result. Hot-stage microscopic study gave detail picture of the meso state of these LC compounds. Some of the pictures of the meso state of these LC polymers are shown here.

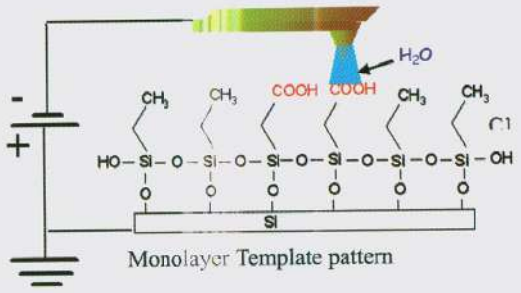


Cholesteryl Acrylate polysulfone at 141.5^0 C.

Laboratory setup for LC polymer study.

Development of Atomic force Microscope (AFM) based tip induced method for fabrication of templates to be used to make polymer nanowires on self-assembled monolayer

The first requirement for device fabrication is development of patterning technique which will enable to make templates for assembling of nanomaterials. We use atomic force microscope based nanolithography technique called Constructive Nanolithography (see figure) which differs conceptually from other lithographic techniques that make use of organic monolayers as passive ultrathin resists. Constructive Nanolithography is used to create nanopatterns of chemically active groups on a highly ordered monolayer of OTS (n-octadecyltrichlorosilane) self-assembled on silicon, via a local electrochemical oxidation process carried out with a conducting SFM (Scanning Force Microscope) tip converting the surface exposed $-CH_3$ groups of the base monolayer to –COOH sites. In this approach, the local electrochemical oxidation is limited to the selective oxidation of only the top groups of the organic monolayer coating, the initial compact structure and molecular organization of the monolayer being thus preserved. The idea is to nanofabricate such template for synthesis and growth of polymer nanowires on the templates.

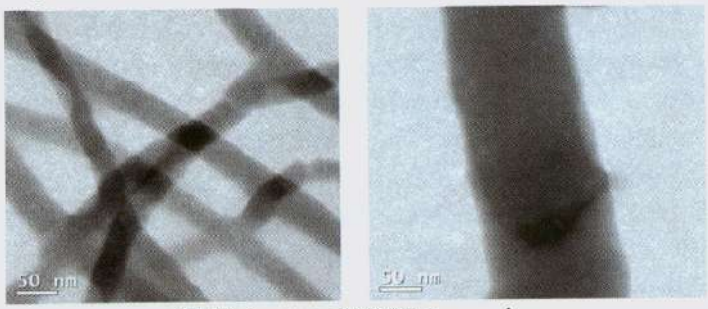


The process showing Constructive Nanolithography

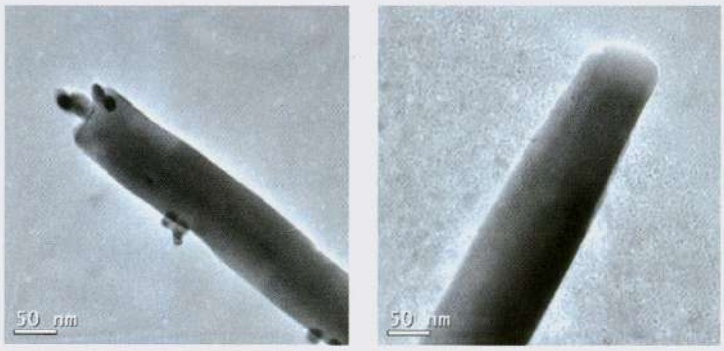
Synthesis of modified nanostructured material of conducting polymer and investigating its use as chemical sensor

Conducting polymers with tunable electrical conductivity, has been the subject of intense study due to its application potential in diverse fields such as microelectronics, displays electrodes. For example, sensors and actuators, membranes for gas separations and solar cells fuel cells. Electrically conducting polymers, termed as "fourth generation of polymeric materials" with their unique redox properties, when doped appropriately, can have electrical conductivity over the full range from insulator to metallic. As a result a large number of synthetic protocols have been developed including incorporation of application-specific functionalization in the polyaniline (PANI) backbone and synthesizing PANI nanofibers, nanotubes, metal nanoparticle–PANI composite, and carbon-nanotube doped PANI. Conductive PANI finds application as chemical sensor. The sensitivity of PANI as sensor can be increased many fold if the polymer is assembled molecularly thin in one dimension in the form of wires. It is because it will results in increase of surface active sites in the polymer backbone thus enhancing its efficiency. Moreover polymer-based nanodevices should have advantages of low cost, flexible, and controlled chemistry.

We carry out polymerization of aniline by chemical oxidation of aniline by appropriate oxidant for example ammonium peroxidisulfate in an acidic medium. To synthesize polyaniline nanowire we use camphor sulfonic acid as dopent and reaction is carried out without stirring and at low temperature (0° C) to inhibit faster reaction rate of polymerization helping in suppressing secondary growth and facilitate formation of PANI nanowires. Figure shows some of the representative transmission electron microscope (TEM) image of PANI nanowire. Synthesis of Au/PANI nanowire was also carried out by reacting aniline monomer with $HAuCl_4$ via a self-assembly process in the presence of camphor sulfonic acid as dopant and surfactant (figure)

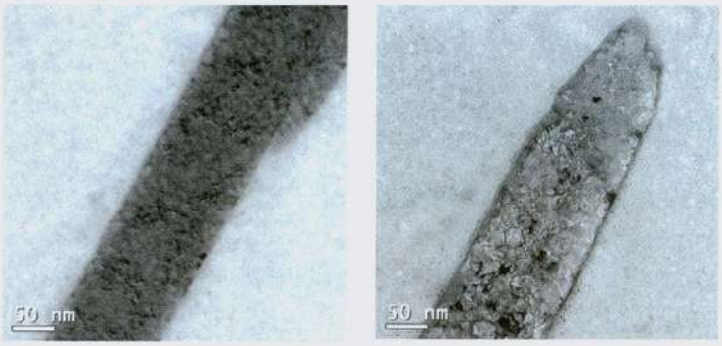


TEM image of PANI nanowire



TEM image of Au@PANI nanowire

Ni NPs can be selected deposited on the surface of PANI. Figure shows the TEM images of Ni coated PANI nanowire.

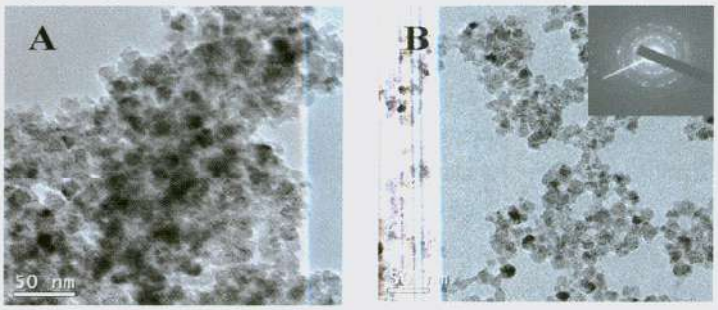


TEM image of Ni coated PANI nanowire.

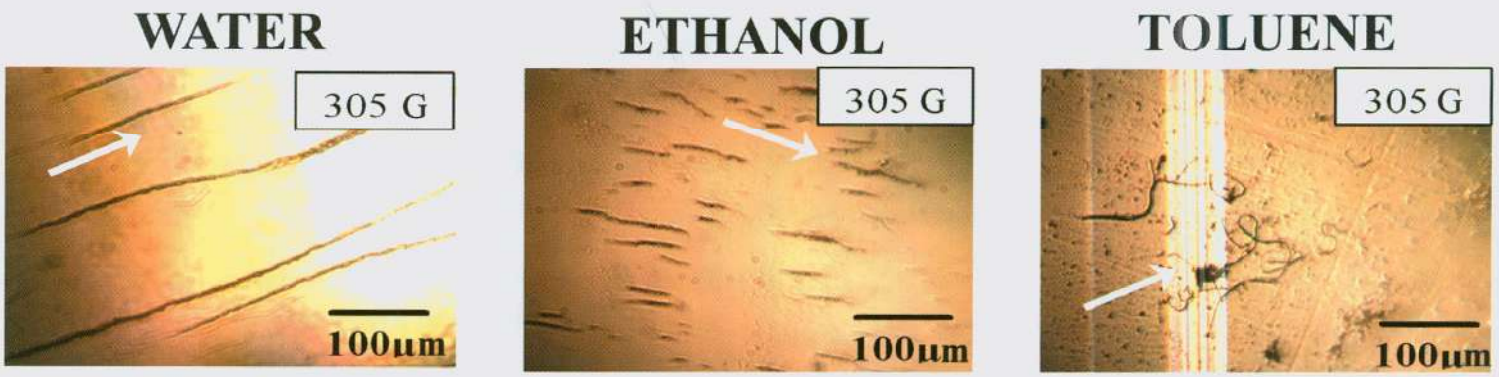
The use of Ni coated PANI nanowire as a.c impedance sensor for detection of cigarette smoke was investigated. It was observed on exposed to cigarette smoke there was four order decreases in the impedance value of PANI-CSA-Ni nanowire. Cigarette smoke contains host of carcinogens. When these organic cacogenic gaseous absorbs onto PANI-CSA-Ni nanowire, it forms a weakly associated charge transfer complex with Ni as the binding site on the polymer nanowire as a result the mobile charge carrier increases in thae system thus decreasing the a.c impedance. Such material has potential application in smoke detector devices.

Synthesis of hydrophilic magnetic nanopaticles and to study the assembly of magnetic nanoparticles and its ways to control the assembling of magnetic nanoparticles

In this work attempt has been made to prepare hydrophilic polyvinylpyrrolidone (PVP) capped $CoFe_2O_4$ magnetic nanoparticles (PVP@$CoFe_2O_4$). The sizes of the PVP@$CoFe^2O_4$ nanoparticles were below 20 nm. Figure shows the tansmission electron microscope (TEM) image of $CoFe_2O_4$ and PVP capped $CoFe_2O_4$. The magnetic properties of the nanoparticles was studied and found to be weakly ferromagnetic. These magnetic particles can be assembled on surface in the form of wires and junctions by application of magnetic field. Hence such hydrophilic magnetic nanoparticles have capability of manipulation with external magnetic field thus can be very useful for biological purposes. The role of different solvent like water, ethanol and toluene in assembling of PVP@$CoFe_2O_4$ was also investigated. The effect of magnetic field in assembling process was also studied. It is observed that water dispersion of PVP@$CoFe_2O_4$ gives longer wire like assembly as compared to ethanol which gives shooter wire assembly. On the contyary, in toluene dispersion there is no such assembly on applying magnetic field.



Transmitted electron microscope images of (A) cobalt ferrite NPs (B) PVP@ cobalt ferrite NPs (inset) selective area electron diffraction (SAED) pattern of PVP@ $CoFe_2O_4$ nanoparticles. The respective dispersion solution was prepared in hexane.



The one-dimensional assembly of PVP@$CoFe_2O_4$ nanoparticles in different dispersion medium under unidirectional magnetic field of 305 gauss (G). The direction of the field in each case is shown by arrow.

A.2. Research Projects

A.2.1 Ongoing

Project-1. Development of RF plasma polymerization process for deposition of hard, transparent and corrosion resistant coatings on bell metal and surface modification of muga silk fibers.
Sponsored by BRNS, Department of Atomic Energy, Govt. of India.

Amount and duration- Rs. 22.71 Lakh, (2007-2010).
Prof. Joyanti Chutia- Principal Investigator
Prof. D. S. Patil, BARC- Principal Co-ordinator
Dr. A. R. Pal- Co- Principal Investigator
Dr. H. Bailung- Co-Investigator
Mr. A. J. Choudhury – JRF

Project-2. Basic experiments on multicomponent plasma with negative ions.
Sponsored by Department of Science and Technology, Govt. of India
Amount and duration Rs. 32.00 Lakh, (2005-2008).
Dr. H. Bailung- Principal Investigator
Prof. Joyanti Chutia- Co-Investigator
Ms. S. K. Sharma - JRF
Ms. K. Devi - JRF

Project-3. Investigation on collective processes in laboratory dusty plasma.
Sponsored by Indian Space Research Organization (ISRO), Govt. of India.
Amount and duration-Rs. 9.48 Lakh, (2006-2009).
Dr. H. Bailung - Principal Investigator
Prof. Joyanti Chutia- Co-Investigator
Mr. M. K. Deka - JRF

Project-4. Study of sheath phenomena and instability in post magnetron discharge.
Sponsored by Department of Science and Technology, Govt. of India under DST-Women scientist scheme.
Amount and duration-Rs. 10.32 Lakh, (2007-2010).
Dr.P.Kalita Boruah- Principal Investigator

Project-5. Ab initio calculations of vibrational and thermodynamic properties of oxides under pressure
Sponsored by Department of Science and Technology, Govt. of India under Fast-Track scheme.
Amount and duration-: Rs. 10.92 Lakh, (2007-2010).
Dr. Munima B Sahariah- Principal Investigator

Project-6. Studies on the discharge characteristics of pulsed plasma system for synthesis of conducting polymer films.

Sponsored by Department of Science and Technology, Govt. of India under Fast-Track scheme.
Amount and duration-Rs. 19.35 Lakh, (2009-2012).
Dr. A. R. Pal - Principal Investigator

Project-7. Study of Polymeric Foam and their uses in Laser-Plasma Experiment.

Sponsored by Department of Atomic Energy, Govt. of India (No-2004/37/22/BRNS/412)
Amount and duration- 28.90 Lakh (2005-2008).
Prof. N. N. Dass- Principal Investigator,
Prof. Joyanti Chutia- Co-Principal Investigator
Dr. N. S. Sarma- Co- Principal Investigator).

Project-8. Development of Liquid Crystalline Polymers.
Sponsored by MIT, Govt. of India (No.1 (2)2006/M&C dated 26.9.2006).
Amount and duration- 20.73 Lakh (2006-2009).
Dr. Neelotpal Sen Sarma- Principal Investigator,
Prof. Joyanti Chutia- Co- Principal Investigator
Samiul Haque- JRF

Project-9. Surface self-assembly @ constructive nanolithography enroute to polyaniline based nano devices.
Sponsored by Department of Science and Technology, Govt. of India under Fast-Track scheme (No-SR/FTP/CS-45/2007).
Amount and duration- 18.72 Lakh (2008-2011).
Dr. Devasish Chowdhury- Principal Investigator.

Project-10. CSIR-SRF Research Project:
Title: Metal oxide deposition on bell metal by rf magnetron sputtering plasma.
Research Fellow: Hemen Kakati
Supervisor: Prof. Joyanti Chutia

Project-11. CSIR-SRF Research Project:
Title: Study on the transitional effect from metallic to reactive mode for protective coatings of titanium nitride on bell-metal and its correlation on the plasma properties by cylindrical magnetron sputtering.
Research Fellow: Sankar Moni Borah
Supervisor: Dr. Heremba Bailung

A.3. Publications

A.3.1. In Cited journals

1. **A. R. Pal, R. L. Bruce, F. Weilnboeck, S. Engelmann, T. Lin, M-S Kuo, R. Phaneuf, and G. S. Oehrlein** (2009): Real-time studies of surface roughness development and reticulation mechanism of advanced photoresist materials during plasma processing, J. Appl. Phys.**105**, 013311.

2. **Sankar Moni Borah, Arup Ratan Pal, Heremba Bailung, Joyanti Chutia** (2008): Study on the influence of nitrogen on titanium nitride in a dc post magnetron sputtering plasma system J. Phys. D: Appl. Phys. **41**, 195205.

3. **Sankar Moni Borah, Arup Ratan Pal, Heremba Bailung, Joyanti Chutia** (2008): Optimization of plasma parameters for high rate deposition of titanium nitride films as protective coating on bell-metal by reactive sputtering in cylindrical magnetron device, Applied Surface Science **254**, 5760.

4. **Sankar Moni Borah, Arup Ratan Pal, Heremba Bailung, Joyanti Chutia** (2008): Hardness study of titanium nitride thin films deposited on bell-metal by cylindrical magnetron sputtering, , Indian Journal of Physics **82**(5), 147.

5. **Sumita Kumari Sharma, Kavita Devi, Nirab Chandra Adhikary, and Heremba Bailung** (2008): Transition of ion-acoustic perturbations in multicomponent plasma with negative ions, Phys. Plasmas **15**, 082111

6. **H. Bailung, Y. Nakamura, and Y. Saitou** (2008): Observation of ion-acoustic shock wave transition due to enhanced Landau damping, , Phys. Plasmas **15**, 052311

7. **F. Sayed, M. M. Haider, A. A. Mamun, P. K. Shukla, B. Eliasson, and N. Adhikary** (2008): Dust ion-acoustic solitary waves in a dusty plasma with positive and negative ions, Phys. Plasmas **15** ,063701

8. **Prafulla Chetri, Narendra Nath Dass and Neelotpal Sen Sarma** (2008): Synthesis, characterization and conductivity measurement of poly (2-vinyl pyridine) complex in nano fine state, Polymer Buletin **61**,11

9. **Prafulla Chetri, Narendra N. Dass and Neelotpal Sen Sarma** (2009): Investigations on pyridinium salts as a solid state ionics, Journal of Applied Polymer Science **112**(3), 1444

10. **Prafulla Chetri, Neelotpal Sen Sarma and Narendra Nath Dass** (2009): Synthesis and characterization of Poly-1, 3-dimethylol diacrylate propane-2-ol and its use as foam, Asian Journal of Chemistry **21**(6), 4612

11. **Devasish Chowdhury** (2009): Combination of self-assembly and nanolithography as an effective nanofabrication methodology for device realization, Current Science **96**(7), 923.

12. **David Groh, Ravindra Pandey, Munima B Sahariah, Emilie Amzallag, Isabelle Baraille and Michel Rérat** (2009): First-principles study of the optical properties of BeO in its ambient and high pressure phases, J. Phy. Chem. Solids (doi:j.jpcs.2009. 03.013/)

13. **Munima B Sahariah and Subhradip Ghosh** (2008): Ab initio calculation of lattice dynamics in BeO, J. Phys. Condens. Matter **20**, 395201

14. **Charudatt Y Kadolkar and Munima B Sahariah** (2008): Point defect simulations by finite cluster method, Computational Materials Science **44**, 443.

A 3.2. Conferences

1. H. Kakati, A. R. Pal, H. Bailung and Joyanti Chutia, (2008): "The influence of RF power and gas pressure on the surface characteristics of aluminium oxide deposited by rf magnetron sputtering" Proceedings of the National Symposium on Plasma Science and Technology, BARC, Mumbai, India

2. Manoj Kumar Deka, Nirab Chandra Adhikary and Heremba Bailung (2008): "Effect of magnetic field on dust charging process", Proceedings of the National Symposium on Plasma Science and Technology, BARC, Mumbai, India

3. A. J. Choudhary, H. Kakati, A. R. Pal, H. Bailung and Joyanti Chutia (2008): "Synthesis and characterization of plasma polymerized styrene films by RF discharge, Proceedings of the National Symposium on Plasma Science and Technology, BARC, Mumbai, India

4. Sankar Moni Borah, Heremba Bailung and Joyanti Chutia (2008): "Characteristics study of reactive discharge in dc magnetron plasma", International Workshop on the Frontiers of Modern Plasma Physics, Trieste, Italy

5. A. R. Pal, R. L. Bruce, F. Weilnboeck, S. Engelmann, T. Lin, M-S Kuo, R. Phaneuf, and G. S. Oehrlein, (2008): "Study of surface roughness development and reticulation mechanism of advanced photoresists in real-time during plasma etching in an inductively coupled reactor", 23rd national symposium on plasma science and technology, BARC, Mumbai, India.

6. Kavita Devi, Sumita K Sharma and H. Bailung (2008): "Production and characteristics of low temperature and low density plasma using magnetic filter", 23rd national symposium on plasma science and technology, BARC, Mumbai, India

7. Sumita K Sharma, Kavita Devi and H. Bailung(2008): "Characteristics of ion acoustic waves (Modified Korteweg de Vries solitons) in multicomponent plasma with negative ions" 23nd National Symposium on Plasma Science and Technology, Mumbai, India

8. Neelotpal Sen Sarma, Prafulla Chetri and Narendra Nath Dass (2009): "Preparation and Ionic conductivity measurement of poly (2-vinyl pyridine) H2SO4 in solid state", Presented in the National Seminar on Recent Advances in Chemical Sciences, held at Dibrugarh University, Dibrugarh, March 26-27

9. Munima B Sahariah and Subhradip Ghosh (2008): "Phonon dispersion and elastic constants in wurtzite-BeO" Proceedings of the 53rd DAE Solid State Physics Symposium

A.4. Patent applied

1. Dr. Neelotpal Sen Sarma, Prof.. Narendra Nath Dass and Dr. Prafulla Chetri have registered for a patent "A Novel Polyelectrolyte and a Process for the Preparation thereof", Application No. – 1350/KOL/2006 dtd. 12/12/2006.

2. Prof.. Narendra Nath Dass, Dr. Neelotpal Sen Sarma and Dr. Prafulla Chetri have registered for one more patent "Synthesis of a Novel Adhesive Solid Polyelectrolyte", Application No. – 966/KOL/2007 dtd. 06/07/2007

A .5. Conference / Workshop / Exhibition attended

1. Mr. S. M. Borah attended International Workshop on the Frontiers of Modern Plasma Physics, International Centre for Theoretical Physics (ICTP), Trieste, Italy, during 14 – 25 July, 2008.

2. Mr. S. M. Borah attended Workshop on Recent Trends on Polymer Science, Institute of Advanced Study in Science and Technology (IASST), Guwahati, 20 – 25 October, 2008.

3. Mr. S. M. Borah attended 23rd National Symposium on Plasma Science and Technology, "PLASMA 2008", Bhabha Atomic Research Centre (BARC), Trombay, Mumbai, India, during 10 – 13 December, 2008.

4. Mr. S. M. Borah attended DST-SERC School on Science & Technology of Processing Plasmas, Birla Institute of Technology, Mesra, Ranchi, 15 – 27 December, 2008.

5. Mr. S. M. Borah attended DST-SERC School on Nonlinear Dynamics, Institute of Advanced Study in Science and Technology (IASST), Guwahati, 2 – 21 February, 2009.

6. Mr. H. Kakati attended Workshop on Recent Trends on Polymer Science, Institute of Advanced Study in Science and Technology (IASST), Guwahati, 20 – 25 October, 2008.

7. Mr. H. Kakati attended the National Symposium on Plasma Science and Technology-2008 held at BARC, Mumbai, India in December, 2008.

8. Mr. H. Kakati attended the Workshop on Introduction to Matlab and Labview, held at Physics Department, Gauhati University in December, 2008.

9. Mr. H. Kakati attended the 4th Advanced School on Nanoscience and Technology held at S. N. Bose National Centre for Basic Sciences, Kolkata in January, 2009.

10. Mr. H. Kakati attended the DST-SERC School on "Nonlinear Dynamics", Institute of Advanced Study in Science and Technology (IASST), Guwahati, 2 – 21 February, 2009.

11. Mr. A. J. Choudhury attended Workshop on Recent Trends on Polymer Science, Institute of Advanced Study in Science and Technology (IASST), Guwahati, 20 – 25 October, 2008.

12. Mr. A. J. Choudhury attended 23rd National Symposium on Plasma Science and Technology, "PLASMA 2008", Bhabha Atomic Research Centre (BARC), Trombay, Mumbai, India, 10 – 13 December, 2008.

13. Mr. A. J. Choudhury attended DST-SERC School on "Science & Technology of Processing Plasmas", Birla Institute of Technology, Mesra, Ranchi, 15 – 27 December, 2008.

14. Mr. A. J. Choudhury attended DST-SERC School on "Nonlinear Dynamics", Institute of Advanced Study in Science and Technology (IASST), Guwahati, 2 – 21 February, 2009.

15. Ms. K. Devi attended International Workshop on the Frontiers of Modern

Plasma Physics, International Centre for Theoretical Physics (ICTP), Trieste, Italy, 14 – 25 July, 2008.

16. Ms. K. Devi attended 23rd National Symposium on Plasma Science and Technology, "PLASMA 2008", Bhabha Atomic Research Centre (BARC), Trombay, Mumbai, India, 10 – 13 December, 2008.

17. Ms. K. Devi attended DST-SERC School on "Science & Technology of Processing Plasmas", Birla Institute of Technology, Mesra, Ranchi, 15 – 27 December, 2008.

18. Ms. K. Devi attended DST-SERC School on "Nonlinear Dynamics", Institute of Advanced Study in Science and Technology (IASST), Guwahati, 2 – 21 February, 2009.

19. Ms. S. K. Sharma attended 23rd National Symposium on Plasma Science and Technology, "PLASMA 2008", Bhabha Atomic Research Centre (BARC), Trombay, Mumbai, India, 10 – 13 December, 2008

20. Ms. S. K. Sharma attended DST-SERC School on "Nonlinear Dynamics", Institute of Advanced Study in Science and Technology (IASST), Guwahati, 2 – 21 February, 2009..

21. Mr. M. K. Deka attended Workshop on Recent Trends on Polymer Science, Institute of Advanced Study in Science and Technology (IASST), Guwahati, 20 – 25 October, 2008.

22. Mr. M. K. Deka attended 23rd National Symposium on Plasma Science and Technology, "PLASMA 2008", Bhabha Atomic Research Centre (BARC), Trombay, Mumbai, India, 10 – 13 December, 2008.

23. Mr. M. K. Deka attended DST-SERC School on "Science & Technology of Processing Plasmas", Birla Institute of Technology, Mesra, Ranchi, 15 – 27 December, 2008.

24. Mr. M. K. Deka attended DST-SERC School on "Nonlinear Dynamics", Institute of Advanced Study in Science and Technology (IASST), Guwahati, 2 – 21 February, 2009.

25. Mr. N. C. Adhikary attended Workshop on Recent Trends on Polymer Science, Institute of Advanced Study in Science and Technology (IASST), Guwahati, 20 – 25 October, 2008.

26. Mr. N. C. Adhikary attended DST-SERC School on "Nonlinear Dynamics", Institute of Advanced Study in Science and Technology (IASST), Guwahati, 2 – 21 February, 2009.

27. Mr. N. C. Adhikary attended the "Workshop on Introduction to Matlab and Labview", held at Physics Department, Gauhati University in December, 2008.

28. Dr. A. R. Pal attended 23rd National Symposium on Plasma Science and Technology, "PLASMA 2008", Bhabha Atomic Research Centre (BARC), Trombay, Mumbai, India, 10 – 13 December, 2008.

Dr. A. R. Pal attended DST-SERC School on "Science & Technology of Processing Plasmas", Birla Institute of Technology, Mesra, Ranchi, 15 – 27 December, 2008.

30. Dr. A. R. Pal attended DST-SERC School on "Nonlinear Dynamics", Institute of Advanced Study in Science and Technology (IASST), Guwahati, 2 – 21 February, 2009.

31. Dr. H. Bailung attended 23rd National Symposium on Plasma Science and Technology, "PLASMA 2008", Bhabha Atomic Research Centre (BARC), Trombay, Mumbai, India, 10 – 13 December, 2008.

32. Dr. Munima B. Sahariya attended DST SERC School on 'Non-linear Dynamics' held in IASST, Guwahati from Feb 02-21, 2009.

33. Dr. Munima B. Sahariya attended 53rd DAE Solid State Physics Symposium help in BARC, Mumbai (2008).

34. Dr. Munima B. Sahariya attended DST SERC school on Computational Statistical Physics held in IIT, Guwahati from December 01-21 (2008).

35. Mr. Samiul Hoque attended Workshop on Recent Trends on Polymer Science, Institute of Advanced Study in Science and Technology (IASST), Guwahati, 20 – 25 October, 2008.

A .6. Research Collaborations

Prof. Joyanti Chutia has collaboration with:
Prof. D. S. Patil, Laser & plasma technology division, BARC, Mumbai
Area of Research: Plasma processing

Dr. H. Bailung has collaboration with:
Prof. Y. Nakamura, Institute of Space and Aeronautical Science, Japan
Area of Research: Dusty plasma, plasma diagnostics

Dr. A. R. Pal has collaboration with:
Prof. G. S. Oehrlein, University of Maryland, USA
Area of Research: Plasma processing

Prof. Narendra Nath Dass has collaboration with:
1. Prof. Aradhana Dutta, Polymer Science, Deptt. of Chemistry, Dibrugarh University, Assam, India.
Area of Research- Polymer Science
2. Prof. Ravi K. Khardekar, Centre for Advanced Technology, Indore, India.
Area of Research- Laser Polymer
3. Prof. K.G. Bhattacharyya, Gauhati University, Guwahati, India
Area of Research- Physical Chemistry
4. Prof. H.C. Pant, Visiting Scientist, BARC, Mumbai
Area of Research- Laser Polymer
5. Dr. M. Sukla, Scientist, Purnima Lab, BARC, Mumbai
Area of Research- Laser Polymer

Dr. Neelotpal Sen Sarma has collaboration with:
1. Prof. O.K. Medhi, Gauhati University, Guwahati, India
Area of Research- Physical Chemistry
2. Prof. J.N. Ganguli, Gauhati University, Guwahati, India.
Area of Research- Inorganic Chemistry

Dr. Devasis Chowdhury has collaboration with:
1. Prof. Arun Chattopadhyay
Indian Institute of Technology, Guwahati
2. Prof. Jasob Sagiv
Weizhann Institute of Scince, ISRAEL

A.7. Lectures delivered on invitation

1. Prof. Joyanti Chutia delivered a talk on "Challenges and future Research in Post-Magnetron Plasmas" at the DST-PSSI Interaction meeting held on 10th -11th April, 2008 at IPR, Gandhinagar.

2. Prof. Joyanti Chutia was invited to deliver a popular talk on "Future clean energy" during the inauguration of PGDBM 2008 at Assam Institute of Management on 7th July'08.

3. Prof. Joyanti Chutia, was invited as a resource person to talk entitled "Plasma Assisted Magnetron Sputtering" on 22nd December,2009 at the first DST - SERC school on "Science & Technology of Processing Plasmas" held at BIT Ranchi during Dec 15-27 2008.

4. Dr. H. Bailung delivered a lecture on "Experiments in dusty plasma" at Department of Physics, Yokohama National University, Japan in September, 2008.

5. Dr. H. Bailung delivered a lecture on "Electrostatic probes" in DST-SERC School on "Science & Technology of Processing Plasmas", held at Birla Institute of Technology, Mesra, Ranchi during 15 – 27 December 2008.

6. Dr. H. Bailung delivered an Invited Talk on "Characteristics of ion acoustic solitary waves in multicomponent plasma with negative ions" in 23rd National Symposium on Plasma Science and Technology "PLASMA 2008", Bhabha Atomic Research Centre (BARC), Trombay, Mumbai, India, 10 – 13 December 2008.

7. Dr. H. Bailung delivered a lecture on "Experiments on nonlinear dynamics in plasmas" in SERC School on Nonlinear Dynamics held at IASST during Feb 2 – 21, 2009.

8. Dr. Neelotpal Sen Sarma gave a talk titled "Poly-electrolytes used in Solid State Ionics" at "National workshop on Recent Trends in Polymer Science" organized by IASST at Don Bosco Institute, Guwahati on 24th October 2008.

9. Dr. Devasish Chowdhury gave a talk titled "Surface Self-assembly of nanomaterials", in "Correl", Nanotechnology Forum at Indian Institute of Technology Guwahati.

10 . Dr. Devasish Chowdhury gave a talk titled "Conducting polymer nanomaterials" at "National workshop on Recent Trends in Polymer Science" organized by IASST at Don bosco Institute, Guwahati on 24th October 2008.

A. 8. Other activity

Prof. Joyanti Chutia wrote an article on "My Experience with Research" in "Lilavati's Daughters", the women scientists of India, 2008 by the Indian Academy of Sciences and edited by Rohini Godbole and Ram Ramaswamy.

A. 9. Seminars / Trainings Organized

A. 9.1. Report of the DST-SERC School on "Nonlinear Dynamics" February 2-21, 2009

DST-SERC School on "Nonlinear Dynamics" was organized by the Institute of Advanced Study in Science and Technology (IASST) at Guwahati during February 2-21, 2009, under the sponsorship of Department of Science and Technology, Government of India. The venue of the school was at Don Bosco Institute, Guwahati.

The aim of the school was to introduce the emerging areas of Nonlinear Dynamics to young researchers who are engaged in or willing to initiate their research in this field. The school course consisted of fundamental and working areas of Nonlinear Dynamics with a special course on Plasma Physics and related Nonlinear Phenomena. Well known experts were invited to deliver lectures. Laboratory sessions on Computer labs and plasma labs had also been organized. Participants were introduced to hands-on experiments to demonstrate the basic ideas of nonlinear dynamics.

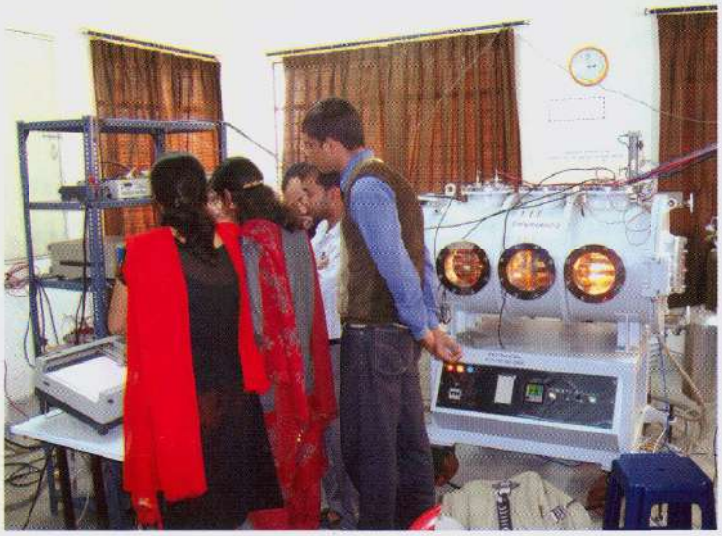
Participants of the DST-SERC school 2009 attending Theory class

Participants of the DST-SERC school 2009 attending Theory class

In the beginning, Prof. Joyanti Chutia, Director of the School welcomed the participants and other resource persons present and thanked other resource persons who agreed to deliver the lectures during the school. She also explained the aim of the school in brief. The school was attended by 34 research students and

young faculty members from different Institutions and Universities. Fifteen resource persons were invited from different National Research Institutes, IITs and Universities as per decision of the planning committee of the school. All of them accepted the invitation and delivered their lectures on the related topics. The Xeroxed copies of some lectures and all the lectures in CD had been distributed among the participants. All total 156 lecture hours were held for the completion of whole course.

The Nonlinear Dynamics (ND) on basic course was followed by special course on ND in Plasma Physics.



Participants of the DST-SERC school 2009 engaged in experimental work

Following three books were distributed among the participants.

i) Nonlinear Dynamics and Chaos by Steven H. Strogatz.

ii) Chaos and Structures in Nonlinear Plasmas by W. Horton and Y. H. Ichikawa.

iii) How Order Emerges from Chaos in the Universe by Steven H. Strogatz.

Moreover, 20 books related to ND were displayed and used by the participants during the school. There were fruitful, intensive and exciting interactions of the participants with the resource persons. The exercise sessions, discussions and experimental classes along with computer labs had been conducted very smoothly.

The participants were seen motivated to the areas of Nonlinear Dynamics and questions asked to the resource persons after each lecture were evident of the success of the classes.

The participants attended all the classes including computer classes and took deep interest in performing the experiments after learning to do from the experts. Tutorial classes seemed to be very interactive and the participants regularly did home-works.

Participants of the DST-SERC school 2009 engaged in experimental work

The experimental classes were carried out in the Plasma lab of IASST. The lecture programmes and the computer classes were held at Don Bosco Institute where food and accommodations were also arranged for all the participants and the resource persons. As a result, it was convenient for all to have good interactions.

The resource persons were able to ignite the juvenile minds of enthusiastic participants and make them aware of the excitations and emerging challenges in this area.

In the last day, the participants presented their research activities briefly and also expressed how much they had benefited by attending the school.

The Director distributing the certificates to the students of DST-SERC School 2009

Prof. Alika Khare, IITG was requested to be an observer and have feed back from the participants about the school. Prof. Khare attended the concluding session and she is to submit the report to the Chairman of the Planning Committee, DST-SERC School on Nonlinear Dynamics.

A tour around the city (First Sunday) and Shillong (Second Sunday) was arranged by the local organizing committee of the school.

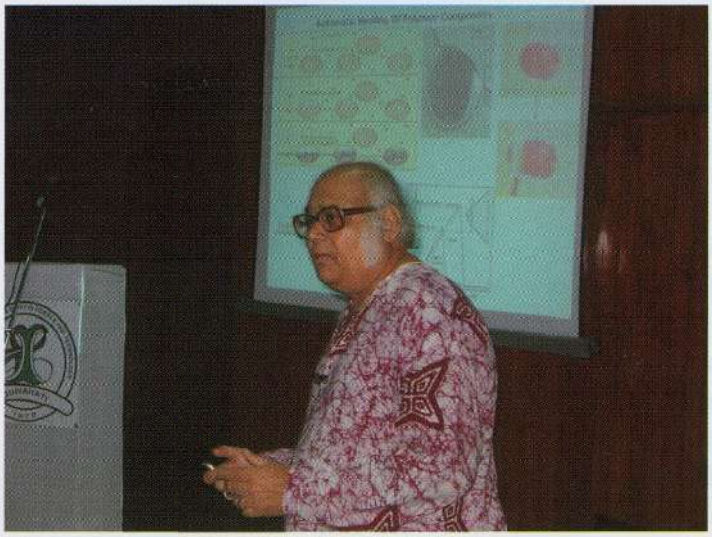
In all, the school was a grand success.

A.9.2. National Workshop on Recent Trends in Polymer Science

The National Workshop on 'Recent Trends in Polymer Science' was inaugurated on 20th October by Prof. OK Medhi, Vice-chancellor of Guwahati University at the auditorium, IASST. The inaugural function was presided over by Prof. K.M. Pathak, former Vice-chancellor Tezpur University & Chairman, IASST council. Prof. Joyanti Chutia, Director, IASST welcomed the participants both from academia and industry and hoped that they will be benefited from the workshop.

Prof. Joyanti Chutia, Director, IASST address at the inaugural function.

Prof. N.N. Dass, former Director of the Institute spoke about the objective of the workshop. The main objective is to educate the young scientists with the development of Polymer Chemistry. The Chief Guest of the meeting Prof. Sandeep Kumar of Raman Research Institute, Bangalore termed the present age as the plastic age. He referred to the great work done by Prof. Chandrasekhar of Discotic liquid crystal, a small sub – class, which has recently emerged as a new class of organic semiconductor. Prof. AK Banthia, IIT, Kharagpur gave an illuminating key note address titled "Polymers Inspiration & Perspiration". He dwelt on the development of biopolymers for surgery, bio-glasses, artificial heart, skin, and suture. He also discussed the development of polymeric materials for drug delivery system, micro encpiluation, molecular designing and nano composite materials. Dr.Neelotpal Sen Sarma, offered the vote of thanks to the dignitaries, invited guests, faculties, well wishers, participants, staff, students and sponsors like DST (GoI), CSIR (GoI), DIT (GoI), GAIL India Ltd and ASTEC, Assam.



Key-note address by Prof A.K. Banthia of IIT Kharagpur.

The workshop comprised of 24 lectures given by 13 resource persons covering different topic of Polymer Science. The first two lectures were given by Prof. AK. Banthia. His talk was titled

The part of august gathering at the inaugural function.

"Biomedical application of polymers". He showed the use of polymer composite materials that are being used as

material of choice for hip replacement, knee replacement, and artificial foot, artificial skin and self healing polymer skin. He also talked on drug delivery. Prof. Sandeep Kumar gave a general introduction of liquid crystal, its classification, properties and application. Prof. NN Dass of IASST discussed about radical polymerization. The most of the lectures were delivered by competent speaker and are eminent scientist from different corners of India. Prof. Arun Chattopadhyay of IIT Guwahati gave talk on "Polymers in Nano Science and Technology". Prof. SK Dolui of Tezpur University talked on three topics and these are "Photluminescence and electroluminescence of pi-conjugated polymers", polymerization reaction using supercritical carbon dioxide as polymerization medium and its advantages and polymer composite material with special emphasis on nano-composites. Dr. Dilip Kakoti of Gauhati University talked on conducting polymers. Dr. SK Nema of Institute of Plasma research, Ghandinagar, Gujrat gave an overview of plasma polymerization and its application along with safe disposal of plastic/polymer waste and energy recovery using plasma pyrolysis technology which is actually very relevant in today's world. Dr. SD Baruah of NEIST, Jorhat lectured on the recent developments in atom transfer radical polymerization. Chromatography was taught by Prof. BC Goswami of Gauhati University. Dr. Parameswar Iyer of IITG gave a lecture on "conjugated polymer as optoelectronics and sensors". He talked about use of new polymers in OLEDs applications. On the last day of the workshop Prof. Krishna Gopal Bhattacharyya of Gauhati University gave lecture on polymers and pollution. He talked about the current problem of plastic waste and waste management. There was a small laboratory session of two hours where participants were shown the different laboratory instruments of Plasma and Polymer Section and there uses.

Resource persons with the participants.

The Workshop was ended with a small cultural program presented by Songs and Drama Division, Ministry of Information and Broadcasting, GoI.

A. 10. Visit Abroad

1. Dr. H. Bailung visited Yokohama National University, Japan to carry out research work on Dusty plasma as a visiting scientist during September 8-October 6, 2008

2. Mr. Sankar Moni Borah participated in the International Workshop on the Frontiers of Modern Plasma Physics, held at International Centre for Theoretical Physics (ICTP), Trieste, Italy during 14 – 25 July 2008.

3. Ms. K. Devi participated in the International Workshop on the Frontiers of Modern Plasma Physics held at International Centre for Theoretical Physics (ICTP), Trieste, Italy during 14 – 25 July 2008.

A.11. Divisional manpower

Dr. H. Bailung, Ph. D - Associate Professor and Head (i/c)
Prof. N. N. Dass, Ph. D - Honorary Professor
Dr. Neelotpal Sen Sarma, Ph. D - Assistant Professor
Dr. Arup Ratan Pal, Ph. D - Assistant Professor
Dr. Devasish Chowdhury, Ph. D - Assistant Professor
Dr. Putul Kalita Boruah - DST Woman Scientist
Dr. Minima B. Saharia - DST Fast Track Scientist
Mr. Nirab Chandra Adhikary - Sr. Research Assistant
Mr. Sankar Moni Borah - SRF
Mr. Hemen Kakati - SRF
Ms. Sumita Kumari Sharma - SRF
Ms. Kavita Devi - JRF
Mr. Manoj Deka - JRF
Mr. Samiul Hoque - JRF
Mr. Arup Jyoti Choudhury - JRF
Mr. Krishna Kanta Swargiari- Mechanic (Technician)
Mr. Bipul Das - Messenger (Peon I)
Mr. Niren Sarma - Lab Attendant (Technical Helper)
Mr. Kabindra Deka - Lab Attendant (TilL 26-07-08)

B. Life Sciences Division

The North East region of India is said to be the treasure house of bio-resources, such as medicinal and aromatic plants, herbs, different types of animals, insects etc. The scientific basis of their use is yet to be established. This valuable knowledge needs scientific documentation and systematic investigation for validation and standardization so that people can get the sufficient benefit from these natural resources. With this view the Division of Life Sciences of IASST has been working on the basic as well as applied field of research on certain priority areas in three sections

1) Biochemistry and Medicinal plants
2) Seri-Biotechnology
3) Bio-fertilizer.

In the Biochemistry and Medicinal Plants section, scientists explore the natural resources like medicinal and aromatic plants, herbs, fruits etc used by the local people for treatment of various ailments in the rural and hilly areas of the region in general and Assam in particular. Scientists have also undertaken study on other health related problems of the people of the region. Scientists of the Seri-biotech section engaged themselves in the study of various aspects of the Muga, Eri and other silk worms and fibers.In the Biofertilizer section, work on Biodiversity of Microbes of NorthEast Region and their Biotechnological applications with special reference to Biofertilizer, Biopesticide and Degraded Ecosystem Management is going on.

B.1.Research activities

B.1.1. Biochemistry and Medicinal plant section:

The main objective of this section is to explore the potentialities in respect of the health care of some exclusive plant species of this region for the greater benefit of the society. Presently Scientists of this section are concentrating on the traditional/ folk medicine used against the liver ailments, hyperglycemia, inflammatory problems, Skin ailments etc. Isolation, identification and manipulation of active phyto-constituents present in some medicinal plants/ fruits of this region used by people living in the villages and hilly areas against various diseases have been taken up for study.

Hydroalcoholic extract of *Clerodendron colebrookianum* leaf lowers serum cholesterol and enhanced serum high-density lipoprotein (HDL).

Clerodendron colebrookianum (CC) Walp (Family,Verbenaceae) is used extensively in the treatment of hypertension in traditional medicine of Northeastern (NE) region of India. Recent studies demonstrated its hypolipidemic activities. However, to be clinically useful, more scientific data are needed. Therefore, in the current study an attempt has been made to observe the dose dependent effect of the hydroalcoholic extract (HE) of CC leaf on hyperlipidemia and lipid peroxidation in oxidative stress induced rats.

a) Preparation of hydroalcoholic extract

Clerodendron colebrookianum (CC) leaves were collected from the medicinal plant garden of IASST and shade dried for 2 weeks. The dried plant materials were then milled to coarse particles and extracted as follows:

350g of CC powdered leaves were extracted with 3500ml ethanol (80%) by cold maceration process for 72 hours. The extracts were then concentrated in a rotary evaporator (Rotavapor R-124) and dried in an oven at temperature of 40^0 C to constant weights. The dried flaky masses obtained were weighed to give percentage yields (11%) and were stored in the refrigerator until needed.

b) Animals and basal diet composition

The animals used in the study were adult male Wistar albino rats (150-200g) obtained from our Institute animal house. Rats were housed in specific standard laboratory conditions for one week. The animals were kept in a temperature- controlled environment (25 ± 2^0 C), and with a regular 12 h light/ 12 h dark cycle. All animals were fed with a standard diet and water *ad libitum*. The study was approved by the Institute animal ethics committee (IAEC).

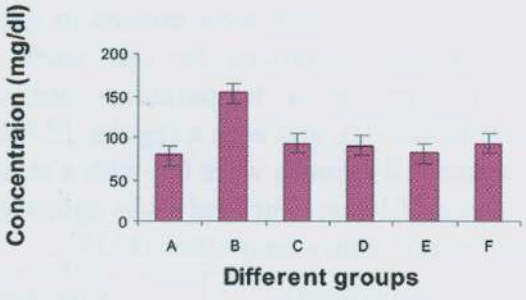
Sl. no.	Ingredients	Amount (gm/kg diet)
1	Whole wheat	270
2	Yellow corn	250
3	Barley	150
4	Milk	150
5	Bone meal	10
6	Calcium chloride	10
7	Salt	10
8	Oil150	(166 ml oil)
9	Vitamin B_{12}	4 tab

c) Group studied

Following 6 groups were considered for our study
Group A: basal diet and water (Control) upto 28 days.
Group B: basal diet + cholesterol (25mg/kg/day) upto 28 days.
Group C basal diet + cholesterol (25mg/kg bw) + CC (0.25g/kg/day) upto 28 days.
Group D: basal diet + cholesterol (25mg/kg bw) + CC (0.5g/kg/day) upto 28 days.
Group E: basal diet + cholesterol (25mg/kg bw) + CC (1g/kg/day) upto 28 days.
Group F: basal diet + cholesterol (25mg/kg/day) + fenofibrate (65mg/kg/day) upto 28 days.
Rats of groups C, D and E were orally fed with hydroalcoholic extract of CC in 3 different dose and rats of group F were fed with standard drug Fenofibrate. At the end of the 28 days overnight-fasted animals were sacrificed by under light ether anesthesia. Blood (2 - 3ml) was collected by heart puncture and serum was separated by centrifugation. Plasma total cholesterol (TC) was determined by the method of Zlatkins (Zlatkins et al., 1953). high-density lipoprotein-cholesterol (HDL-C) were determined using test kits from Randox.

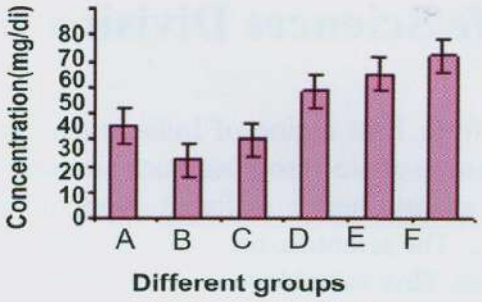
d) Results and discussion

Changes in plasma cholesterol (TC) level (mg/dl) in different groups. A= control, B= cholesterol feeding group, C= cholesterol + CC extract (0.25g /kg) feeding group, D= cholesterol + CC extract (0.5g/kg) feeding group, E= cholesterol + CC extract (1g/kg) feeding group and F= cholesterol + fenofibrate (65mg/kg) feeding group. Values are mean ± SE. N=6.



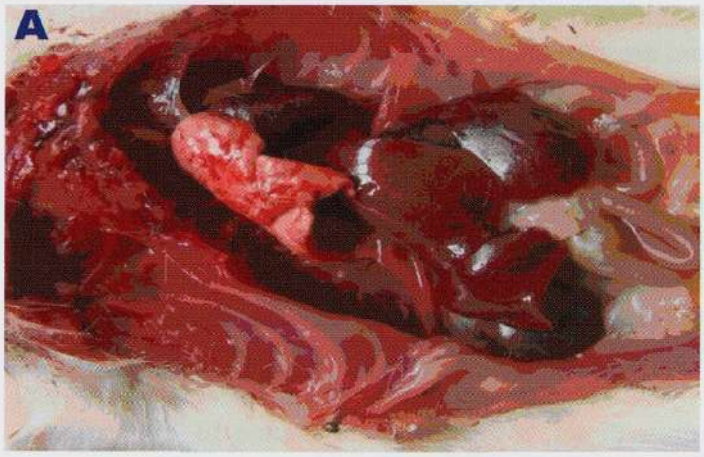
Total cholesterol in plasma

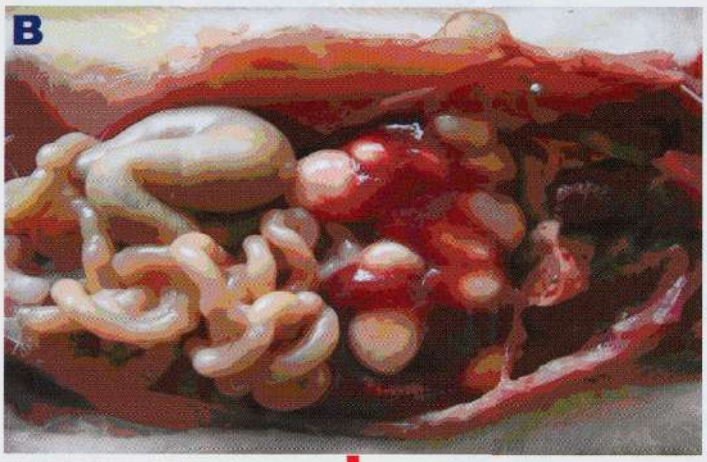
Changes in plasma high-density lipoprotein (HDL-C) level (mg/dl) in different groups. A= control, B= cholesterol feeding group, C= cholesterol + CC extract (0.25g /kg) feeding group, D= cholesterol + CC extract (0.5g/kg) feeding group, E= cholesterol + CC extract (1g/kg) feeding group and F= cholesterol + fenofibrate (65mg/kg) feeding group. Values are mean ± SE. N=6.



HDL concentration in plasma

Photos below shows the reduction of liver lipid droplets after feeding of the hydroalcoholic extract of the aerial part of *Clerodendron colebrookianum*. A = Control, B = Cholesterol feeding group, C = Cholesterol + 0.25g/ kg/day hydroalcoholic extract feeding group, D = Cholesterol + 0.5g/ kg/day hydroalcoholic extract feeding group, E = Cholesterol + 1g/ kg/day hydroalcoholic extract feeding group





In the present study dose dependent hypolipidemic and antiperoxidative activity of leaf extract of CC was observed in high cholesterol fed rats. Enhancement of cardioprotective lipid HDL-C in a dose dependent manner after oral administration of CC extract was another interesting finding of the present study. Our study suggests that CC leaf could be a potent cardioprotective agent, in view of the inverse correlation between HDL-C levels and the risk of coronary heart disease (Tall et al.1998). This effect was not observed before with a single dose of CC leaf extract (Devi et al, 2004)

Antifungal activities of some medicinal plants of Assam against Dermatophytes.

It has been observed that the various types of skin diseases due to the fungal infection are the most prevalent throughout the tropical and subtropical countries due to the high degree of atmospheric moisture. Because of the poor hygienic conditions and lack of proper health care system most of the rural and hilly people of this region are prone to many diseases, most frequent and common being the skin disease, caused by various fungi, the most predominant is the dermatophyte. The problem is more aggravated with increasing environmental pollution, exposure to industrial toxicants, food adulteration, malnutrition, injudicious use of drugs etc. Many people using natural resources like medicinal herbs/plants available locally for the treatment of these ailments and these works miraculously. The Division has also taken interest in this field and started working for developing some remedy from such medicinal plants for the fungal infection, particularly on the Dermatophytes to start with initially. Researchers had contacted some such Vaidyas/ Herbalists /Traditional practitioners etc of this locality for getting information of medicinal plants used for treatment of such diseases.

To begin with, in-vitro and in-vivo studies of some medicinal plants against few selected Dermatophytes have been taken up. The Dermatophyte samples include Trichophyton rubrum, Trichophyton mentagrophytes, Trichophyton tonsurance, Microsporum fulvum, Microsporum gypsum etc. The plant extracts have shown very good results in the in-vitro studies and are now undergoing in-vivo study for confirmation. Various Toxicity studies are essential for future use of the remedies in human being. Scientists have under taken the study of the toxicity of the selected plant extracts against different models of animals.

a) In-vitro antifungal screening

The in-vitro antifungal screening is done by Agar cup diffusion methods (Collins and Lyne 1976 and/or Motiejunaite & Peciulyte 2004, and/or Harami et. al 2006,). In brief, at first 200µl of fungal suspension in distilled water is uniformly spread over already solidified Sabroud Dextrose Agar and Sabroud Choramphenicol Agar plates with the help of a spreader or a cotton swab. Wells of 6-9 mm diameter are made in the centre of these agar plates with the help of a sterile cork borer. The wells are then filled with the respective test extract and allowed to diffuse at room temperature for half an hour. Then the plates are incubated at 30±2°c for 96 hours to 3 weeks depending on the growth rate of the test pathogen. The antifungal activity of the extracts is determined by measuring the

diameter of the inhibition zone around the well that is filled with the extracts. DMSO (2%) was used as a vehicle and Clotrimazole was used as a +tvc control. Results are average of three plates. We have given some code numbers to the extracts. Mix extract 1 contains 68(c), SG2(c) c), 79(c), 79(PE) and 68(M) extracts. Mix extract 2 contains 79 (w), SG1 (M), and 79(M) extracts. Concentration where full growth was observed are termed as complete mycelial development (CMD). Mixed extract 1 and 2 mixed together to get the Mixed extract Final (MEF). Initially we had tested the efficacy of the extracts on Plates following standard protocol

Test Fungi	Inhibition Zone (cm) Conc. of extract (µg/ml)							
	C	10,000	5,000	2,500	1,250	625	312.5	156.25
Trichophyton mentagrophyte	0	5.3	4.5	4.0	3.1	2.7	1.9	1.0
Trichophyton rubrum	0	5.0	4.3	3.9	3.0	2.3	1.6	1.2
Microsporum fulvum	0	6.2	5.0	4.4	3.7	2.8	1.9	1.0
Microsporum gypseum	0	6.0	5.1	4.3	3.4	2.8	1.3	0.8

In- vitro results of Mixed extract Final against dermatophytes

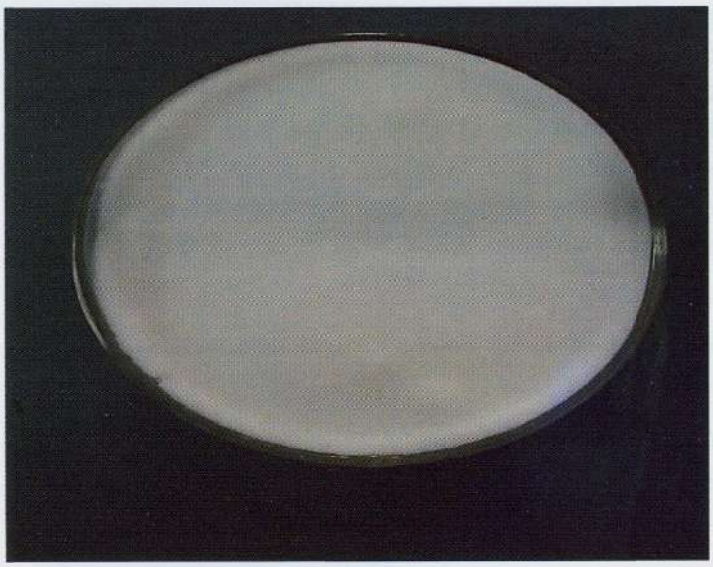
Test Fungi	Inhibition Zone (cm) Conc. of extract (µg/ml)							
	C	10,000	5,000	2,500	1,250	625	312.5	156.25
Trichophyton mentagrophytes	0	5.2	4.5	4.0	3.1	2.7	1.9	1.0
Trichophyton rubrum	0	5.4	4.6	4.0	3.3	2.7	1.8	1.2
Microsporum fulvum	0	6.0	5.3	4.8	4.0	2.8	1.9	1.0
Microsporum gypseum	0	6.2	5.6	4.4	3.4	1.9	1.3	0.8

In- vitro results of Mixed extract 1 against dermatophytes

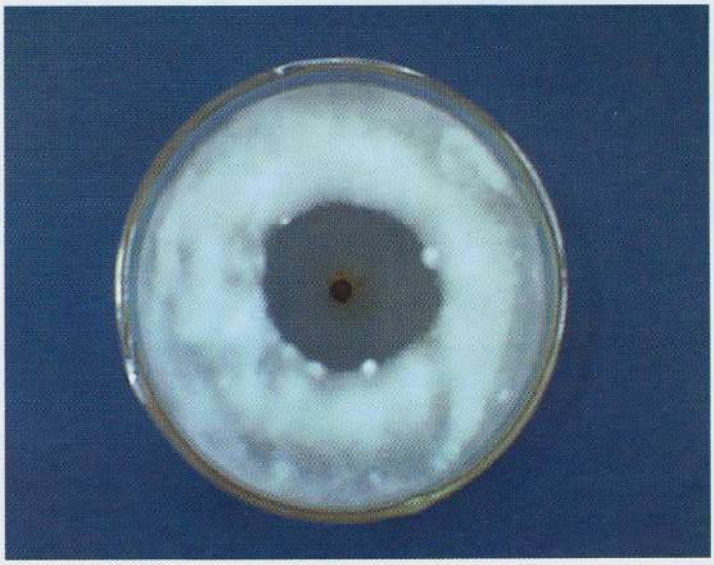
Test Fungi	Inhibition Zone (cm) Conc. of extract (µg/ml)							
	C	10,000	5,000	2,500	1,250	625	312.5	156.25
Trichophyton mentagrophytes	0	4.75	3.27	2.27	1.40	0.93	0.85	CMD
Trichophyton rubrum	0	42	3.6	2.73	1.80	0.75	CMD	1.2
Microsporum fulvum	0	4.42	3.68	2.78	1.83	1.08	0.83	CMD
Microsporum gypseum	0	3.06	2.40	1.65	1.25	0.80	CMD	CMD

In- vitro results of Mixed extract 2 against dermatophytes

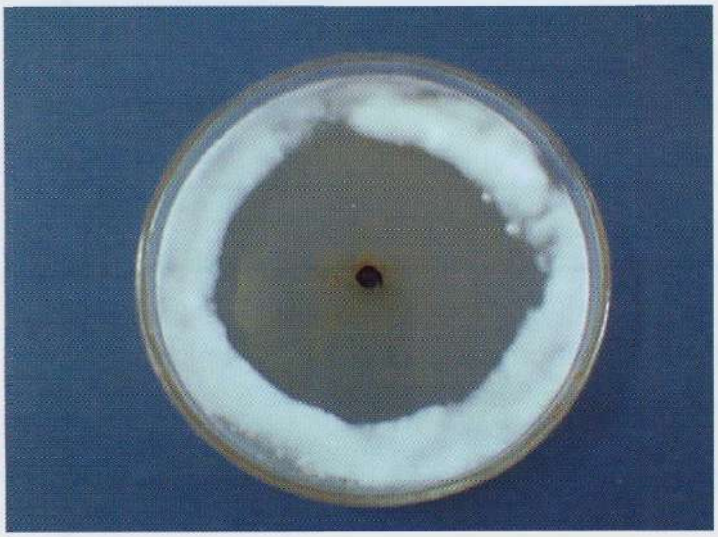
IN-VITRO PHOTOGRAPHS OF MIX EXTRACT FINAL AGAINST TRICOPHYTON RUBRUM



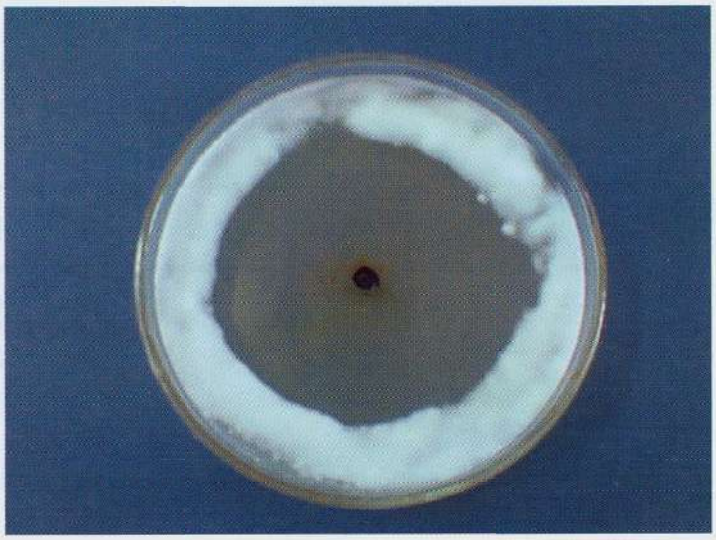
Trichophyton rubrum control



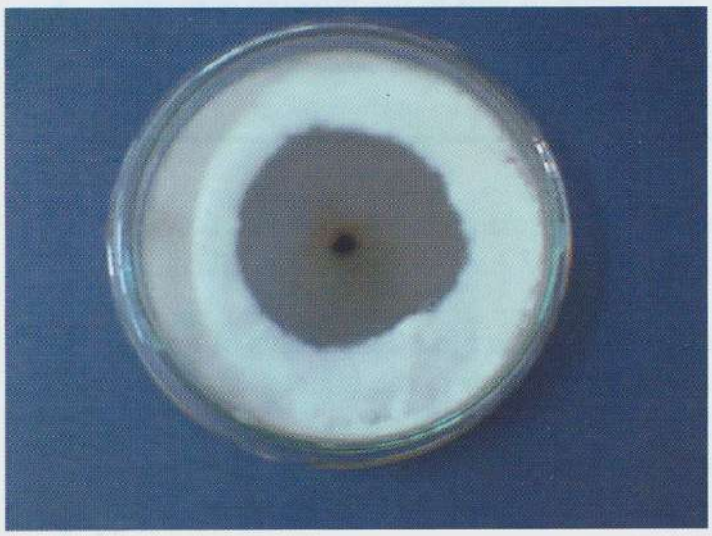
Mix Extract Final (1250 µg/ml) against Trichophyton rubrum



Mix Extract Final (10,000 µg/ml) against Trichophyton rubrum



Mix Extract Final (312.5 µg/ml) against Trichophyton rubrum



Mix Extract Final (2500µg/ml) against Trichophyton rubrum control

b) In-vivo antifungal screening

Preparation of the Mix Extract

All the extracts weighted in equal amounts and thoroughly mixed together in a base. The mixed extract consists of the following - 68(c), SG2 (c), 79 (c), 79 (PE), 68 (M), 79 (M), 79 (W), and SG1 (M) extracts of plants, in equal amounts. This formulation is named as Mixed Extract Final (MEF) and is prepared in different concentrations 2%, 5%. 10% and 15%. Guinea pigs infected with different dermatophytes were treated separately with different concentrations.

In-vivo tests

The in-vivo antifungal screening is carried out using

healthy adult guinea pigs of albino strain. At first fungal inoculums were prepared for infection. Guinea pigs were clearly clipped of their hair in both the flanks and 10mm incisions were created and the area is slightly scarified by using a scalpel. The fungal inoculums are applied on incision and the area is covered with cloth bandage and tied with leucoplast following the standard international protocol.

In each in- vivo test animals were grouped as- 1) Treatment group, 2) Positive control group and 3) Negative control group. Guinea pigs infected with different dermatophytes were treated with the prepared MEF with concentrations ranging from 2-10%. The time taken for complete healing is the result of the experiment. Healing signs includes- decrease in erythema, oedema, decrease in the scaling areas and complete recovery of hair in the dermatophytic infected areas. Healing was confirmed by culture negativity on Sabroud Chloramphenicol Agar plates.

In vivo results in Guinea Pigs

Dose	Test Fungus	Inference
2%	Tricophyton rubrum	Disappearance of erythrema after 39 days of topical application, recurrence of hair was not clear till 52 days.
5%	Tricophyton rubrum	Disappearance of erythrema after 27days of topical application, recurrence of hair in the infected area after 6 weeks.
10%	Tricophyton rubrum	Disappearance of erythrema after 19 days of topical application, recurrence of hair in the infected area after 4 weeks.

In-vivo antifungal activity MEF against Tricophyton rubrum in Guinea Pig.

Dose	Test Fungus	Inference
2%	***Tricophyton mentagrophytes***	Disappearance of erythrema after 3 weeks of topical application, recurrence of hair was clear till 6th weeks.
5%	***Tricophyton mentagrophytes***	Disappearance of erythrema after 19 days of topical application, recurrence of hair in the infected area after 39 days
10 %	***Tricophyton mentagrophytes***	Disappearance of erythrema after 19 -21 days of topical application, recurrence of hair in the infected area after 30 days.

In-vivo antifungal activity MEF against Tricophyton mentagrophytes in Guinea Pig.

Dose	Test Fungus	Inference
2%	***Microsporum gypseum***	Disappearance of erythrema after 32-35 days of topical application, recurrence of hair was not clear till 50 days
5%	***Microsporum gypseum***	Disappearance of erythrema after 20-22 days of topical application, recurrence of hair in the infected area after 5 weeks
10%	***Microsporum gypseum***	Disappearance of erythrema after days 15-17 of topical application, recurrence of hair in the infected area after 24 days.

In-vivo antifungal activity MEF against Microsporum gypseum in Guinea Pig.

Dose	Test Fungus	Inference
2%	Microsporum fulvum	Disappearance of erythrema after 30 days of topical application, recurrence of hair was not clear till 45-50 days.
5%	Microsporum fulvum	Disappearance of erythrema after 21 days of topical application, recurrence of hair in the infected area after $4^{1/2}$ -5 weeks.
10%	Microsporum fulvum	Disappearance of erythrema after days 15 of topical application, recurrence of hair in the infected area after 30 days.

In-vivo antifungal activity MEF against Microsporum fulvum in Guinea Pig.

Dermatophyte infected Guinea pig.

Hair growing on the infected Guinea pig skin after treatment

Toxicity Evaluation of Plant Extract :
a) Primary Skin Irritation in Rabbit

Healthy adult rabbits (1.5-2.0 kg body weight) at least three in number of either sex were used. Animals were acclimatized for 7 days to the experimental animal room conditions having temperature 22 ± 3^0 C, humidity 30-70% and 12:12 hrs light dark cycle. Animals were fed standard animal diet and water *at libitum.*

A dose of 0.5 ml of the plant extract was applied to the shaved skin of test side (right flank). The exposed area was tied with aluminium foil and leucoplast. Adjacent areas (left flank) of the skin of each animal served as control for the test.

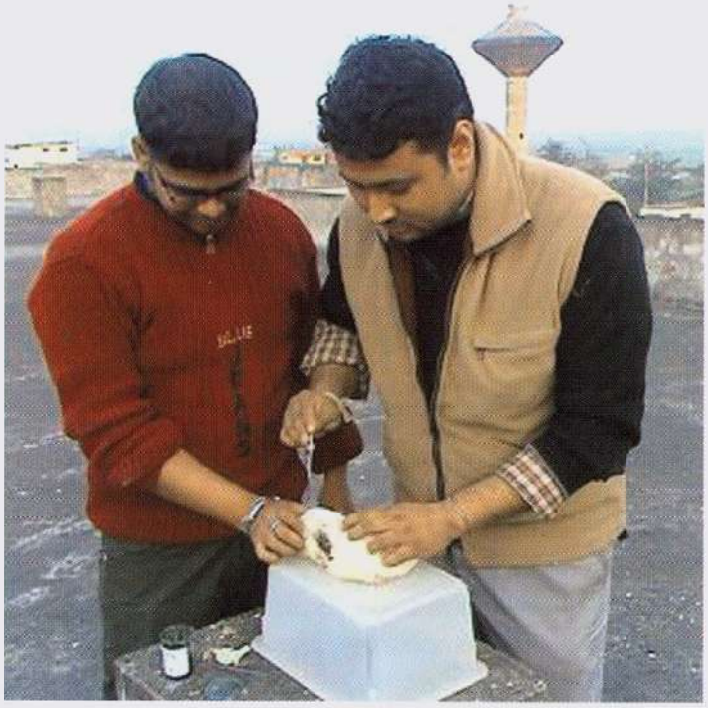
Observations:

Animals were observed for signs of erythema and oedema and the responses scored at 60 min, and then at 24, 48, 72 hours and 7 and 14 days after patch removal. Dermal irritation was scored and recorded as per the grades given in the standard protocol. The extracts were found to be non irritant.

b) Irritation to Mucous Membrane in female Rabbit

Toxicity Evaluation of the Skin ointment on Rabbit

Healthy adult female rabbits (1.5-2.0 kg body weight) (3 numbers) were acclimatized for 7 days to the experimental animal room having temperature 22±3^0 C, humidity 30-70% and 12:12 hrs light and dark cycle. Animals were fed standard animal diet and water *at libitum*.



Research Scholars working on Guinea Pig.

A dose of 0.1 ml of the tested sample was applied to the upper vault of the vagina. Exposure duration was 4 hrs. at the end of the exposure period residual substance were removed using water without disturbing the vaginal epidermis..

Observations:

Animals were examined for signs of erythema and oedema and the responses scored at 60 minutes, 24, 48, 72 hrs and then at 7 and 14 days. Mucous membrane irritation was scored as per the grades followed by the standard protocol. The extracts were found to be non toxic as evident from the above experiment.

Hepatoprotective Efficacy of Medicinal Plants:

Liver ailment is also another common disease of this part of the country. Scientist of this section have collected some data after survey in some Vaidyas/ Herbalists etc, who prescribe remedies prepared from medicinal plants against liver ailments in the villages. After preliminary screening of some collected plants, researchers have selected one herb for studying the efficacy for liver ailments against Peracetamol, Galactosamine and Carbon tetra chloride animal models.

A. Animal treatment- (CCl_4) model

Study of efficacy of the Plant extract of NS-1 against CCl_4 Acute toxicity on Liver of Albino rats (5 day experiment):

Rats were divided four groups having 6 animals each-

Group-I	Normal Control
Group-II	CCl_4 Control
Group-III	Test Extracts (500mg/kg) + CCl_4
Group-lV	Reference (Silymarin) (100mg/kg)

Animal treatment

Group-I (Normal control) Group received of 5% Tween-80 (5ml/kg bw, i. p.) on day-1, day-2, day3& on day-4 & two doses of olive oil (1ml/kg, s.c.) on day-2 and 3.

Group-II (CCl_4 Group) received O.5% Tween-80 like Group-l and given dose of CCl_4 suspension on day-1, day-2, day-3 & on day-4

Group-III (Test Group) received indicated concentrations of extract suspension (i.p.) & CCl_4 suspension (s.c.) on day-1, day-2, day-3 & on day 4.

Group-IV (Reference Group) received indicated concentration of Silymarin suspension (i.p.) in distilled water & CCl_4suspension (s.c.) on day-1, day-2, day-3 & on day 4.

Animals were sacrificed under mild ether anesthesia on day-5 after CCl_4 administration. Blood and liver samples were collected. The liver weight was recorded. The blood samples were allowed to clot for 15-20 minutes and centrifuged at 2000r.p.m for 15 minutes and serum was separated for biochemical studies of- GOT, GPT, ALP, GGT, Cholesterol, Direct bilirubin, Total bilirubin.

Percentage of protection for each biological parameter was calculated as follows assuming that there was no protection (100% damage) in CCl_4 or PCML control group.

Rabbit (albino strain)

$$\% \text{ Protection} = 100 - \left\{ \frac{100}{(\text{Toxin control} - \text{Normal Control})} \right\} \times (\text{MLE \& toxin} - \text{Normal control})$$

Group	Dose	GOT IU/L	GPT IU/L	ALP IU/L	GGT IU/L	Cholesterol Mg/dl	Bilirubin (Mg/dl)	
							Total	Direct
Normal Control	-	22.4±2.6*	34.5±3.68*	47.9±2.91*	48.68±4.14*	41.8±0.33*	1.065±0.21*	0.12±0.026*
CCl_4 Control	CCl_4 +Olive oil (1:1,V/V) 2ml/kg	91.11±2.67*	106.1±1.01*	116.72±1.24*	106.2±2.31*	139.49±0.25*	3.38±0.3*	0.35±0.036*
Test	500mg/kg	42.71±3.13* (58.79)	57.3±2.58* (78.45)	66±3.49* (43.11)	54.63±4.31* (76.32)	57.44±0.28* (84)	1.89±0.44* (84.48)	0.195±0.011* (67.39)
Reference Silymarin)	100mg/kg	37.43±2.59* (44.51)	54.55±6.68* (92.19)	67.7±4.83* (40.25)	59.65±1.58* (76.57)	54.82±0.085* (86.7)	1.47±0.42* (92.4)	0.16±0.025* (39.13)

***P>0.05 Values in parentheses represent % protection**

Effect of Nelsonia canescens (Lam.) on serum enzymes in rats treated with CCl_4 (Acute, 5 Day treatment)
(Values are MEAN±SEM, n=6)

B. Carbon tetra chloride (CCl_4) induced chronic oxicity study in rat. (15 day experiment up to acrifice)

Group-I received four doses of Normal saline1 0ml/kg, p.o. at 12 hour interval and olive oil at a dose of 7.5ml/Kg, p.o 1 hour after the last dose of normal aline.

Group-II received Normal saline like group-1 given dose of CCl_4 suspension (p.o.) 1 hour after the ast dose of normal saline.

Test Group (Group-III) received four doses of ndicated concentrations of extract suspension (p.o) ike group I and II & CCl_4 suspension (p.o.) 1 hour fter the last dose of Methanol extract.

Reference Group (Group IV) received indicated concentration of Silymarin suspension (p.o) like group and II & CCl_4 suspension (p.o.) 1 hour after the last dose of Methanol extract.

All the animals were ad ministered with Pentobarbital (i.p.) 24 hours after the administration of olive oil for Group-I and CCl_4 for the other three groups.

C. Paracetamol (Pcml) induced acute toxicity study n rat (5 day experiment up to sacrifice)

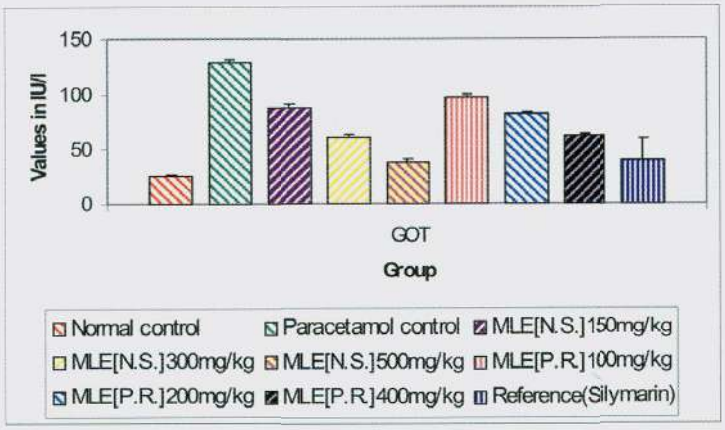
To access the efficacy of the plant extract of NS-1 (methanol), we have undertaken the Paracetamol (PCML) model in rats also. The animals were divided into following groups keeping 6 rats in each group.

Group-I Normal Control
Group-II Pcml Control
Group-III Extract (NS.-1) (150mg/kg) + Pcml
Group-IV Extract (NS.-1) (300mg/kg) + Pcml
Group-V Extract (NS.-1) (500mg/kg) + Pcml
Group-VI Reference (Silymarin100 mg/kg) + Pcml

Animal treatment:

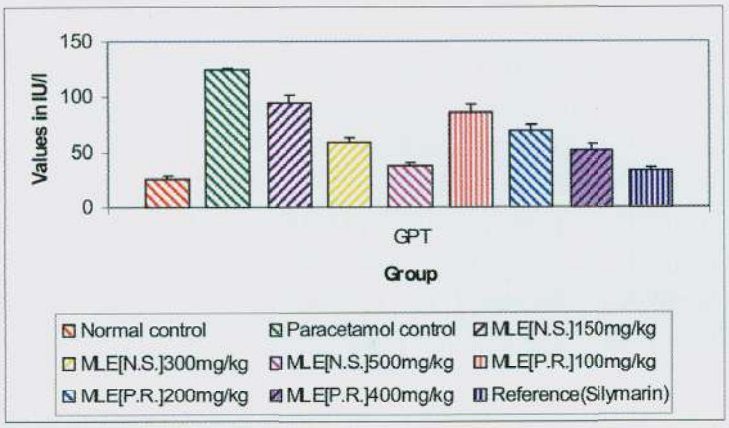
Paracetamol was suspended in 40% (w/v) aquous sucrose soln. and administered (p.o.) at a dose of 2mg/kg, this dose is known to cause liver damage in rats.

Group-I received single daily dose of 5% Tween-80 (5ml/kg, p.o.) for 4 days & a single dose of 40% sucrose soln. (1ml/rat, p.o.) on day 3.
Group-II received single daily dose of 5% Tween-80 (5ml/kg, p.o.) for 4 days & a single dose of Paracetamol suspension (p.o.) on day 3.
Test Groups (Group-III, IV, V of N.S.) received daily dose of indicated concentrations of extract suspension (p.o.) for 4 days & a single dose of Paracetamol suspension (p.o.) on day 3.
Group-VI (Reference group) received daily dose of indicated concentration of Silymarin for 4 days & a single dose of Paracetamol



Effect of Plant extracts on serum GOT in rats treated with Paracetamol (Acute, 5 Day treatment)
(Values are MEAN±SEM, n=6)

Animals were sacrificed under mild ether anesthesia 48 hrs after Pcml. administration. Blood and liver tissues were collected. The liver wt was recorded. The blood samples were allowed to clot and serum was separated for the following biochemical studies of- GOT, GPT, ALP, GGT, Cholesterol, Direct bilirubin, Total bilirubin suspension (p.o.) on day 3.



Effect of Plant extracts on serum GPT in rats treated with Paracetamol (Acute, 5 Day treatment)
(Values are MEAN±SEM, n=6)

In all the experiments the livers were excised and thoroughly perfused in ice-cold water; after drying in blotting paper there wt. were recorded. Few amount of the excised liver were fixed in 10% Formosaline for 48 Hrs for Histopathological study of the liver cells and embedded in paraffin using standard microtomic technique. 5µ thin sections were cut and stained with alum-hematoxylin and eosin stain. The initial and final body wt. of all animals was recorded on 1st day & on 5th day just before sacrifice.The work is in progress.

B.1.2. Seri biotechnology Section

Silk means style and luxury to the wearer, where it simply means survival for the rearer, reeler / spinner and weavers. Silk is royal in its splendor, exotic and sensuous in its radiance, spectacular in vision. No other fabric drapes so beautifully with optimum wearer comforts. Silk is bringing a silent revolution acting as an agent of socialism by enabling money to flow from the hands of the rich to poor.

With the advent of Science, today we have all means of luxuries and comforts. But at the same time we are facing severe crisis like shortage of energy, water, food and global warming. This is basically because we are gradually moving away from nature. It is high time that all of us realize this and make a conscious effort not to detach ourselves from nature. This is exactly where the role of sericulture comes in. Sericulture is a system where plants, animals and human beings co-exist in a symbiotic manner.Keeping this view in mind the following experiments are carried out in this section.

Silkworm rearing

Exploration of Silkworm Biodiversity

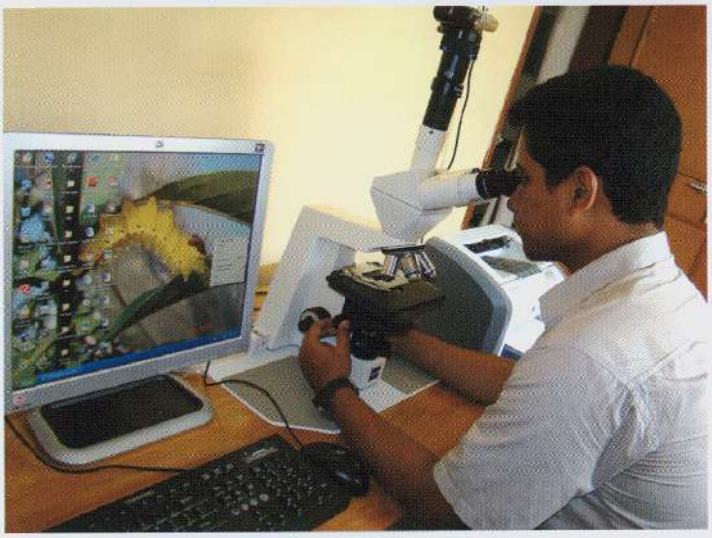
Northeast region is a rich store house of non-mulberry silkworm. Nine species of *Antheraea*, nine species of *Philosamia* and three species of *Attacus* are commonly found in this region where only two of them viz muga and eri have been commercially exploited. The unexplored vast array of natural resources promises commercial potentials and has committed itself to the sustainable utilization as a means of improving the livelihood opportunity of the rural people.

Research scholar at work

No applied scientific work is possible without basic research. It is worth mentioning that *Antheraea* assamensis (Helfer) commonly known as muga silkworm is an indigenous monotypic species which produces shimmering golden - colored silk of high value. This insect exclusively inhabited in the North Eastern part of India, especially in the Brahmaputra valley region. It has four larval colour morphs which are nondiapausing, multivoltine and has a wild counterpart with diapausing/ nondiapausing in nature. Due to lack of breeding program, this silkworm is suffering from inbreeding depression. Hence, attempt has been made to develop a hybrid variety of muga silkworm which will be more productive, resistant to diseases etc.

Study on eggshell and embryonic development of muga silkworm:

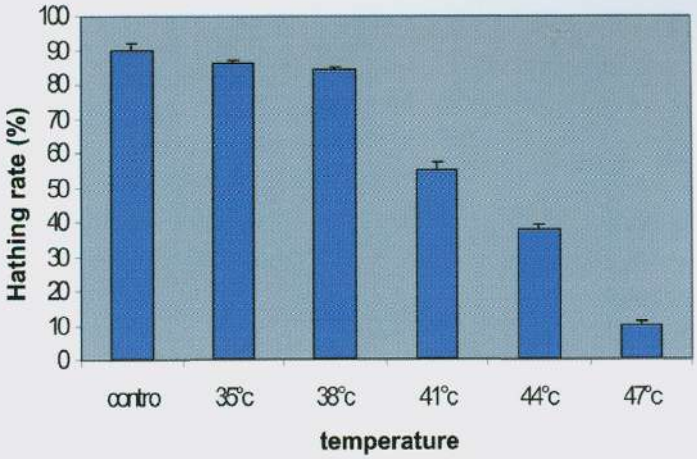
Effect of global warming/ environmental hazard is the factor for low fecundity and hatchability, which affects the muga silk industry. - The eggshell, the covering of oocyte plays the first role to protect the embryo from external factors for the beginning of a new generation. It allows and facilitates sperm entry for the production of a new life. In insects, its structure is species specific, which can be effectively used as criteria in insect taxonomy.



Microscopic observation of eggs

The eggshell is mainly composed of protein with lipids, carbohydrates and some inorganic molecules in small amount. Concentration of metabolites viz. protein, carbohydrate and lipid of eggshell has been estimated and different molecular weight of protein has been characterized by polyacrylamide gel electrophoresis.

The developing egg is very susceptible to environmental conditions like temperature, humidity, light etc. high temperature ranging from 350c to 470c has influence on hatching rate of the larva. The egg showed

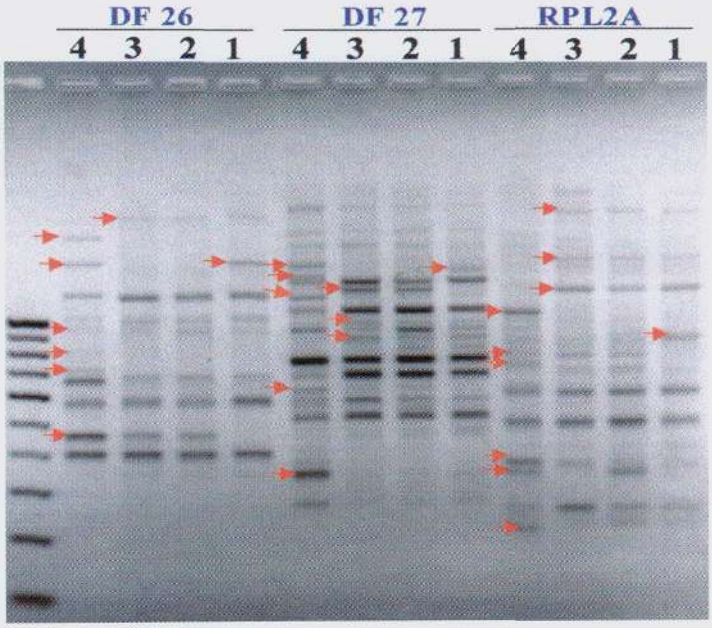


Effect of temperature exposure on hatching rate of egg.

80-90% hatchability for exposures up to 38°C for 2 hours. On exposure to temperature 41°C or above the hatching percentage reduced. Beyond 45°C even at 30 min exposure proved lethal to the eggs.

Study on Taxonomical traits of muga silkworm:

Wing venation of *Antheraea assamensis* Helfer have been studied using Landmark based morphometric analysis. The forewing and hindwing of both the sexes of all morphs (green, blue, orange and wild) of *A. assamensis* have been considered in this study.



RAPD analysis of muga silkworm using three markers

Significant changes in sub veins and anal veins were observed in the forewing and hindwing of all the morphs. The samples were analyzed using geometric morphometric method (TPS software, Rohlf, 2005) and SPSS statistical programme (Version 9.0) has been applied for this purpose.

This analysis show significant differences of the veins among the intraspecies of *A. assamensis,* which is very important from the taxonomic point of view. The Intraspecific population of *A. assamensis,* were analyzed using RAPD markers (DF 26, DF 27, RPL 2A). 10 to 19mambers of bands have been recorded as shown in figure and in each cases 3 to 4 bands are unique in wild morph.

Analysis of Silk Protein using electrophoresis

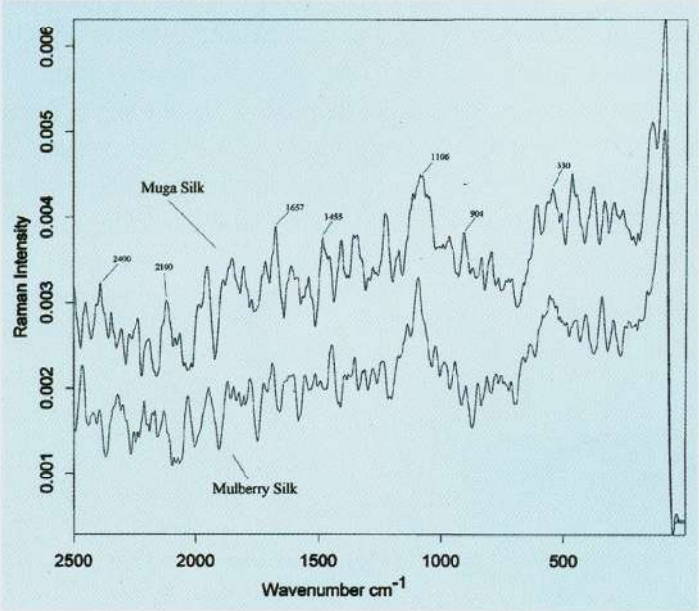
Study on silk fiber:

To increase competitiveness of the silk industries for meeting higher demand in the domestic and export markets, science and technology including information and communication is necessary. Thus a new revolution can be started in the concept of finish product. With this view, the properties of muga silk fibre (Antheraea assama) had been studied with various physical and chemical methods viz. sericin content analysis, dencity, water sorbency, tensile strength, Amino acid analysis

Tensile strength analysis of silk fibre

DSC, FT-IR, Raman Spectroscopy, X-Ray difractogram etc. Properties of other silk fibres like tasar *(Antheraea mylitta)* and Mulberry silk *(Bombyx mori)* had also been studied for reference. Impact of seasonal and geographic variations is evident at economical character and sericin content of cocoons. Muga silk fibre is found to contain highest tensile strength, lowest density and water sorbency.

Study of molecular structure with X-ray Diffraction, Infrared and Raman Spectroscopy had revealed certain significant differences in the structure from mulberry silk. While mulberry silk is stated to be of sheet structure, muga silk shows more helical structure, which explains its stiffness and higher tensile strength. From DSC study, it can be concluded that the decomposition temperature for *A. assamensis* (362°C) is higher than *B. mori* (320°C). Higher decomposition temperature indicates higher thermal stability of muga fibre than B. mori.



Raman spectra of silk

The finding of this study will help in identification of Muga silk and checking of adulteration whenever necessary. The technical data generated from the basic research on muga silk was utilized for obtaining GI Certificate for muga silk of Assam.

Food Plants:

Sericulture is an agro based industry and it comprises of food plants and silkworm. A food plants garden comprising of Som, soalu, Dighalati, Mezankari, Castor, Tapioca, Keseru, Bor Keseru mulberry etc. has been raised at the IASST's campus and has been maintained. The organic manure has been produced using vermi compost technology and the product has been applied to the food plants.

Rearing house and some of the food plants of silkworm.

B.1.3. Biofertilizer Section

Rehabilitation of degraded soil of Upper Assam:

The Biofertilizer unit under Life Sciences Division has been continuing since 1994.Since then the unit has been working on Biodiversity of Microbes of NorthEast Region and their Biotechnological applications with special reference to Biofertilizer, Biopesticide and Degraded Ecosystem Management.

During the period from April 2008 to March 2009 the unit has carried out work on 'Rehabilitation of Degraded Soil of Upper Assam due to Excessive Mining of Coal'. The purpose of the project was to monitor and assess the amount of environment degradation in the area and to rehabilitate/regreening the same with the microbial consortia entrapped from the degraded area. The entrapped microbial consortia were used to produce secondary plants, the materials for rehabilitation or regreening of the degraded area. Mostly the Secondary plants were prepared with *Macroptilium atroperpurium* (Siratro) and *Cajanas cajan* (arahar).

Particularly in the period as mentioned above the following works have been completed and the final report have been prepared and submitted.

1. Monitoring of the transplanted secondary plants.
2. Isolation and Identification of Microbes from the Rhizospheric soils of survived secondary plants
3. Estimation of Nitrogen, available Phosphorus, Organic matter and Organic Carbon from Rhizospheric soil of the secondary plants along with control
4. Compilation, data processing and final report writing.

B.2.Research Projects

B.2.1.Ongoing

Project-1. Development of Broad Spectrum remedy from Natural sources for Health care with special References to Skin ailments
Sponsored by: DRDO, Ministry of Defence, Govt. of India.
Amount and period: Rs. 9.98 Lakh, 2007-2010
Dr.Jibon Kotoky- Principal Investigator
Mr. Kaustav K. Sarma- JRF
Mr. Rubul Saikia- Project Assistant

Project-2. Plant Diversity & Environment Education through Students of Assam.
Sponsored by DST, NESTC Div GOI
Amount and duration: Rs. 10.74 Lakh, 2008 -2009.
Dr. J. Kotoky- Principal Investigator
Mr. Rupam Sarma - Project assistant.

Project-3. Evaluation of antioxidant property of some selected fruits of North East India - a biochemical Approach.
Sponsoed by DST, GoI, New Delhi
Amount and duration: Rs. 12.45 lakh. 2007-2010
Dr (Mrs) Rajlakshmi Devi–Principal Investigator
Prof. D C Deka -Co Principal Investigator
Ms Tiluttoma Mudoi- JRF

Project-4. Study of the effect of leaf extracts of *Clerodendron colebrookianum* Walp (Nefafu) on lipid peroxidation, lipid profile and antioxidant status in cholesterol fed rat
Sponsored by ICMR , GoI, New Delhi
Amount and duration:Rs. 7.98 lakh, 2007- 2010
Dr (Mrs) Rajlakshmi Devi - Principal Investigator
Prof. D K Sharma –Co- Principal Investigator
Mr. Dulal C. Boruah- SRF

Project-5. Development of a package for seed production of muga silkworm
Sponsored by National bank for Agricultural and rural development (NABARD)
Amount and duration: Rs. 16.68Lakhs,
2008- 2011.
Dr. (Mrs) Dipali Devi- Principal Investigator
Mr. Saranga Dutta- JRF
Mr. Krishna Kanta Sarma- Field Assistant

B 2.2. Completed

Project-1. A systematic study on phisico chemical

properties of muga silk (*Antheraea assama*) fiber produced in India
Sponsored by DST, Go I
Amount and duration: Rs 21.45 Lakhs, 2005-2008
Dr. (Mrs) Dipali Devi- Principal Investigator
Dr. K.C. Baruah-Co Principal Investigator
Prof. N.N. Dass-Co. Investigator
Mr. Bijit Talukdar- JRF

Project-2. Development of Grainage of muga silkworm using indoor rearing technique
Sponsored by ASTEC,Govt.of Assam.
Amount and duration: Rs.1.74 lakhs,
2006-2008
Dr. (Mrs) Dipali Devi- Principal Investigator
Ms.Phulmani Choudhury-JRF

Project-3. Rehabilitation of degraded soil of Upper Assam due to excessive mining of Coal.
Sponsored by Ministry of Environment and Forest,
Govt. of India
Duration: 2005- 2008
Dr. P. Azad Principal Investigator
Prof. A.K.Varma Co-Investigator
Ms. N.Nesha JRF

Project-4. Development & Safety Evaluation of Herbal carrier Substances for Skin care ointments
Sponsored by DRDO, Govt. of India
Amount and duration: Rs. 5.00 Lakhs, 2008-2009
Dr. Jibon Kotoky Principal Investigator.

B.3.Publications

B 3.1. In Journals

1. **R. Devi, D.C. Boruah and D.K. Sharma** (2008): Trace elements-Mn,Fe andNi status in eleven medicinal Plants of lower Bhahmaputra valley, Jr. Nature and Environment **1**, 30-34.

2. **Nashimun Nesa and Padum Azad** (2008): Studies on trace metal levels in soil and water of Tipong, Tirap and Tikak collieries of Makum coal field, Tinsukia, Assam. Poll.Res. **27** (2): 237-239.

B 3.2. Conference

1. **Mamata B Sharma and Dipali Devi** (2008): A study of the traditional process of weaving of Muga silk fabrics" Published in the proceedings of the "53rd Annual Technical seminar of Assam Science Society", **9**, 45-54.

B.3.3. Publication of scientific books

1. Dr Dipali Devi is the co author of the book **Asomor Vanya Resomor Jilingoni** written in Assamese published in February, 2009.

B.4. Patent applied

1. Dr. Jibon Kotoky and his group has applied for a patent for a complete 'Herbal base' substance for ointments (No. 2049/DEL/2008.) and additional data as required has been generated and submitted to the patenting authority during this period of report. (Submitted for PATENT jointly with DRL, Tezpur, under DRDO, Govt. of India).

B.5. Paper presented in Conference/ Seminar

1. R. Saikia, K.K. Sharma, P.J.D. Bhuyan, R. Samanta, P. Baruah, and J. Kotoky (2008): "Role of Rhizosphere Mycoflora in degumming of decorticated ramie [Boehmeria nivea (L) Gaud] bast fibre", National seminar on "Bio-Piracy-Imminent Threat to the Conservation of Bio- diversity and Bio-prospecting of the Flora and Vegetation of the North Eastern Region" on 7–8th November, 2008, held at DKD College, Dergaon, Golaghat, Assam, sponsored by UGC, Govt. of India, New Delhi.

2. B. Dasgupta, J. C. Kalita, J. Kotoky, N. Debnath and A. Haque (2008): "Influence of Nelsonia Canescens (LAM) Spreng extract on Carbon tetra chloride induced Hepatotoxicity in rats", National Zoological Congress, Gauhati University from 29th to 31st December, 2008.

3. Dr. J. Kotoky, R. Saikia, Kaustav K Sharma and Rupak Sarma (2009): "Evaluation of Antidermatophytic property of some medicinal plants of Assam", National seminar on Exploration, Utilization and Strategy action plan for Sustainable Management of Plant Resources, sponsored by MOEF, Govt. of India, CSIR, UGC, New Delhi, held at Botany Department, Gauhati University, Assam from 27-28 February 2009.

4. Dr. D. Devi and Phulmani choudhury (2008): "Changes of carbohydrate and protein in the developing healthy and pebrine infected embryo of Antheraea assamensis, Helfer", National Conference on Zoological Society of India held at Gauhati University from 29th to 31st December 2008.

5. Dr. D. Devi, Ramesh Nath, and Arundhuti Choudhury (2008): "Studies on apolipophorin –III level during infection in *Antheraea assamensis*, Helfer", National Conference on Zoological Society of India held at Gauhati University from 29th to 31st December 2008.

6. Dr. D. Devi and Mamta B. Sarma (2008): "Effect of washing on the physical properties of Muga silk (*Antheraea assamensis*) fabric", National Conference on Zoological Society of India held at Gauhati University from 29th to 31st December 2008.

7. Dr. D. Devi and Ramesh Nath (2009): "Protein profile of semidomestcated and wild counterpart of muga silkworm, *Antheraea assamensis* Helfer of Assam", 96th Indian science congresss held at North Eastern Hill University, Shillong from Jan 3-7, 2009.

8. Dr. Dipali Devi and Phulmani Choudhury (2009): "Metabolites and activity of trehalose in developing embryos of *Anthraea assamensis* Helfer",. 96th Indian Science Congress held at North Eastern Hill University, Shillong from Jan 3-7, 2009.

9. Dr. R Devi, D C Boruah, and D K Sharma (2008): "Leafextract of *Clerodendron colebrookianum* inhibits intrinsic hypercholesterolemia and extrinsic lipid peroxidation", National Seminar on "Bio-Piracy – Imminent Threat to the Conservation of Bio- diversity and Bio- Prospecting of the Flora and vegetation of the Northeaster region on 7th and 8th Nov 2008 held at Research Monitoring Cell, Dergaon Kamal Doweram College, Golahgat, Assam.

10. Dr. R. Devi, T. Mudoi and D. C. Deka (2008): "In Vitro Antioxidant Property of Some Selected Fruits of North East India: A Comparative Study with Other Widely used Citrus Fruits", International Conference on Translational Pharmacology and 41st Annual conference of Indian Pharmacological Society held at AIIMS, Delhi from 18th Dec – 20th Dec, 2008.

11. Tiluttama Mudoi, Dibakar C. Deka and Rajlakshmi Devi (2009): "Evaluation of antioxidant activity and trace metal component of some local fruits of Northeast India", 96th ISCA held at North Eastern Hill University, Shillong from Jan 3-7, 2009.

12. D.C.Boruah, R Devi and D.K.Sharma (2009): "Hypolipidaemic activity of aqueous *Clerodendron colebrookianum* leaf extract in acute hyperlipidaemia induced by Triton WR-1339 in rats and its antiperoxidative property", Symposium-cum- Training Programme for Developing Capacity Building of Young Scientists for Carrying out Basic, Clinical and Operational Research in the Field of Nutrition held on 21st-23rd March, 2009 at National JALMA Institute for Leprosy and other Mycobacterial Diseases, Tajganj, Agra (U.P).

B.6. Seminar/workshop/ conference attended

1. Dr. J. Kotoky participated at the workshop in the Regional "Bio-informatics Infrastructure Facility" on the subject-"Molecular Biology & Bio-informatics Tools and their Application in Biological Research", sponsored by the Department of Biotechnology, Govt. of India, and organized by College of Veterinary Sciences, Assam Agricultural University, Khanapara, Guwahati from December 2 - 5, 2008.

2. Dr. J. Kotoky participated in the National Zoological Congress, held at Gauhati University from 29 – 31st December 2008.

3 Dr. Dipali Devi has participated at the National work shop on Bio ethics organized by Regional Institute of medical Sciences, Imphal sponsored by ICMR, Govt. of India held at Imphal during 22 -24th September,2008.

4. Dr. Rajlakshmi Devi attended the Geographical indication: A need for protection & enforcement A Road show on Indo US initiative & Perspectives on 3rd September 2008 at Hotel Landmark, Guwahati.

5. Dr. Rajlakshmi Devi participated in the ICMR-NIH Regional (North East) Workshop on Bioethics at Regional Institute of Medical Sciences, (RIMS) Imphal, Manipur from 22nd–24th September 2008.

B.7. Research Collaboration

Dr. Jibon Kotoky has collaboration with:

1. Dr J. Das, HOD, Dept of Biotechnology, DRL, Tezpur.
Area of Research: Dermatophytes

2. Dr V. Jagdeesan, Sr. Deputy Director (Rtd.) FDTRC, NIN, Hyderabad.
Area of Research: Food Toxicology.

3. Dr. M. Das Rastogi, HOD, Dept. of Food Toxicology, IITR, Lucknow
Area of Research: Toxicological assessment of artificial colours used in Foodstuffs.

4. Dr R.B Raizada, HOD (Retd), Dept. of Drug Toxicology, IITR, Lucknow.
Area of Research: Drug & chemical toxicological evaluation

5. Dr. D.K. Petal, Dept. of Analytical Chemistry, IITR, Lucknow.
Area of Research: Analytical study.

6. Dr P.K. Shukla, Dept. of Fermentation Technology, CDRI, Lucknow.
Area of Research: Plant based drugs development against skin diseases.

7. Dr. Jogen Ch. Kalita, Reader, Dept of Zoology, Gauhati University
Area of Research: Physiology and Hepatoprotective study.

Dr. Dipali Devi has research collaboration with:

1. Prof K.P. Gopinathan, Department of Cell Biology and Microbiology, IISc, Banglore, India.
Area of research: Silkworm Molecular Biology

2. Prof. D.K. Sharma, Department of Zoology, Gauhati University, Assam, India.
Area of research: Insect Biochemistry

3. Prof M. Turchetto, Department of Biology, Paduva University, Italy.
Area of Research: Entomology and Insect Protein Chemistry.

4. Dr. Sisiro Farago, Textile Institute, Milan, Italy.
Area of Research: Fibre Technology.

5. Dr. S.Cappellozza, Institute of Sericulture, Padova, Italy.
Area of Research: Biology and Breeding of Silkworm

Dr. Rajalakhmi Devi has research collaboration with:
1. Dr. S K Maulik, Additional Prof Department of Pharmacology AIIMS, New Delhi.
Area of Research : Cardiovascular study.
2. Dr S K Banerjee, Post Doctorate Fellow Pitsburge University, USA.
Area of Research: Cardiovascular study. 2

3. Dr S Tamuli, Department of Pathology Veterinary College Guwahati-22
Area of Research: Pathological work.

4. Prof. D C Deka, Department of Chemistry, Gauhati University, Guwahati.
Area of Research: Antioxidant Study, Biochemistry

5. Prof. D K Sharma, Department of Zoology, Gauhati University, Guwahati.
Area of Research: Cell & Molecular Biology.

B.8. Lectures delivered on invitation

1. Dr Dipali Devi has delivered an invited talk on "Sericulture biodiversity of Assam and future prospect" at Governor House on 3rd May 2008 at the meting of 'Development of Sericulture in N E Region' invited by the then Governor of Assam, His Excellency Lt Gen (Retd.) Ajai Singh.

2. Dr Dipali Devi has participated as resource person and presented a lecture on "G.I. of Muga silk of Assam, a case study "at the International conference on A Road to Geographical Indication : A Need for protection and Enforcement ,organized byCII Guwahati branch, held at Hotel land mark, Guwahati on 3rd Sept. 2008.

3. Dr Dipali Devi has delivered an invited talk on Importance of G.I and perspective of sericulture in textile at Assam Textile Institute, Guwahati-1 on 6th December, 2008.

B.9. Deputation/assignments

1. Dr. J. Kotoky has been assigned to participate the Seminar on "Geographical indication: A need for Protection & Enforcement – A Road show on Indo –US initiative & Perspective " on 3rd September 2008 at hotel Landmark, Guwahati.

2. Dr. Dipali Devi has been assigned to participate and taken part at the exhibition exhibiting the articles of Seri biotech unit and has demonstrated the test for identification of silk at Longturi Festival at Boko during15-16 July, 2008.

3. Dr. Dipali Devi has assigned to participate at the exhibition exhibiting the articles of Seri biotech unit at Assam Textile Institute, Ambari, Guwahati on 6th December, 2008.

B.10. Other activity

B.10. 1. Collaborative works

1. Dr. Praveen K. Shukla, Sr. Asst. Director, Division of Fermentation Technology, Central Drug Research Centre, Lucknow visited the Division of Life Sciences from 7th to 11th April 2008 as a part of collaborative work.During his visit Dr. Shukla given extensive hands on training on in-vitro as well as in vivo work on Fungal infection particularly on Dermatophytes in various models like rats, guinea pig, rabbits etc.

A lecture was organized on 9th April 2008 and Dr. P. K. Shukla talked on the topic – "Drug Development from plants and Fungal infection" held at the Institute's auditorium.The faculties and students interacted with the speaker as Dr. Shukla, The seminar lecture was presided over by Prof. Joyanti Chutia, Director, IASST.

Dr. P. K. Shukla giving training to the Research Scholars

2. A collaborative work with Ms. Charllotte Kwon of MAIWA handprints Ltd, Vancouver, Canada on Natural dyeing on silk is in progress.

Canadian textile technologist observing the non-mulberry silk of Assam

A team of fibre technologist from Canada has visited the Seri biotech lab. on 2nd Nov 2008 and discussed on various problems and prospects of non mulberry silkworm of this region. They showed keen interest in exchange program, as such organized jointly a workshop was on Non mulberry silkworm and silk of NE region and natural dyeing process on silk during 18-21st Feb.2009 at IASST and Resham gram, Boko.

B.10. 2. Other scientific works

1. The paper on "Sericigenous insects of Assam, India and strategies for their conservation."of Dr. Dipali Devi has been accepted as an oral presentation for XXIII International congress of Entomology held at Durban, South Africa during 6-12 July 2008 and the abstract have been published.

2. Dr. J Kotoky has submitted an Anti-fungal herbal skin formulation to two hospitals in Assam for Clinical trial in the month of December 2008.

3. Mr. Abani Patar, a Post Graduate student from Doon Post Graduate Paramedical College & Hospital, Dehradun, Uttaranchal is working under the guidance of Dr. Jibon Kotoky, Associate Professor for fulfilling his master degree since November 2008.

4. Mr. Indresh Kumar Yadav, M. Sc. Final year students worked at the Life Sciences Division, IASST under Dr. Jibon Kotoky, and Prof . B.C. Goswami, Dept of Chemistry, Gaunhati for fulfilling the Master Degree of Gauhati University during 2008.

5. Mr Pranab Nath of SRM University, Chennai has completed project work during 2008 for fulfillment of master degree in Biotechnology at Seriotech laboratory under the supervision of Dr. Dipali Devi.

B.11. Conference/workshop/ training organized

B.11.1. Training on Identification of silk

A significant contribution of Seribiotech unit during this period is the training on Identification of the silk.

As mentioned earlier a package for identification of silk has been developed and the same has been disseminated to the actual user of silk (Realer, weaver, trader, consumers) through 2(two) training programs during 2008 under the banner of Identification of silk organized at IASST in collaboration with **Silk mark**

organization of India (SMOI), Guwahati Chapter.
The intriguing silk produced by different types of silkworm retains its own distinct features and maintain a high market price as well. Consumers demand special individual characteristic from pure silk fabrics and blending products of pure silk only. So, it is necessary to have 'silk mark' on silk goods for their protection of purity. More than 150 members from different parts of Assam and neighboring states viz West Bengal, Tripura, Meghalaya, Nagaland and Manipur were participated during the training. Series of lectures were delivered on biodiversity of silkworms, food plants, their biology, strategy for conservation, and various types silk fibers and fabric for creation of awareness. They were also explained about the need and advantages of affixing silk Mark label on their products. Hands on demonstration of various methods viz. physical examination, burning, microscopic and solubility (Acid and Alkali) tests were arranged so that the participants can have a first hand knowledge of identification of silk.

B.11.2. Workshop on Non mulberry silkworm and Silk of N.E. region and natural dyeing process on silk.

A regional workshop on "Non mulberry silkworm and Silk of N.E. region and natural dyeing process on silk" was successfully completed at IASST and Resham gram, Boko, organized by Institute of Advanced Study in Science and Technology (IASST), Pashim Boragaon, Guwahati35, ReshamGram, Boko and Maiwa Handprints Ltd, Vancouver, Canada. The Workshop had been organized in association with Department of Biotechnology, Govt. of India, NABARD, Assam Regional office, NEDFi and Guwahati Refinery.

View of inaugural function

Lightening of inaugural lamp

The workshop was inaugurated at IASST auditorium on 18th Feb, 2009 and was presided over by Prof. K.M Pathak Ex V.C. Tezpur University. Dr. Dipali Devi convener of the workshop had highlighted the theme of the workshop and Dr. Joyanti Chutia, Director IASST had welcomed the delegates. Sri L.N. Tamuli, IAS, Commissioner, Handloom, Textile and Sericulture inaugurated the workshop. Sri P.K. Das, Scientist, Central Silk Board was present as the Guest of Honour. Two textile technologists from Canada Ms. Charllotte Kwon and Ms. Shirley Gordon had attended the workshop as resource person and spoken about the development of various technologies in their country. A booklet written in Assamese 'Asomor vanya Resomor Jilingoni' by Dr. Dipali Devi and Mr. Chandan Keshab was inaugurated by Ms. Shirley Gordon.

Workshop book being released by Ms. Shirley Gordon

Two technical sessions were held which were chaired by Prof. N.N. Dass, Ex Director, IASST and Dr. K.C. Baruah, Ex Director, Forensic Science Laboratory, Meghalaya respectively. Three eminent speakers namely, Dr K Jaiswal from Ambedkar University, Lucknow, Dr. B. V. Somasekhar, Director, Fashion Institute of Technology, Hyderabad and Dr. Bishnu A Darugade from Institute of Chemical Technology, Mumbai had spoken on opportunities of entrepreneur development, design

and fashion technology using silk and Green chemistry for textile technology respectively. The four days workshop had been continued at Resham gram, Boko with intensive hands on practical on natural dyeing on non mulberry silk.

Part of the august gathering

The three days practical session on natural dyeing had been continued at Resham Gram, Boko. Ms Charllotte Kwon and Ms Shirley Gordon taught the participants and Mr. Chandan Keshab and Dr. Dipali Devi helped them. The fiber and fabric of eri silk was used for dyeing and 32 types of dyes were applied. Some of them are Indigo, Red, Burgundy, Yellow, Orange, Brown, Green, and Chocolate etc. The locally available dye material like Marigold, Lac, Hena, Catechu, Madder, Indigofera etc in different percentages. The successful workshop came to an end with the distribution of certificates to the participants.

Resource person teaching the theory of dyeing

The exceptional workshop, the first of its kind in Northeast Region was a grand success. Forty one participants comprising of college teachers, research scholars and artisans were highly benefited and expressed their satisfaction through written feedbacks. The workshop was a boon to the people who are earning their livelihood through non mulberry silk of this region adding a new dimension to the Silk Industry.The Canadian technologists were also highly satisfied with the arrangements and working with the most aspirants/energetic participants of the workshop. Seeing the vibrant colour on eri silk they convinced that the people of this region will succeed in carrying out the technique on non mulberry silk. They assured to import the naturally dyed silk as well as dye material of this region. Ms. Charllotte Kwon has committed to help in conducting such type of workshop in other places so that some more people may learn the technique.

Participants at work

Dyed (Natural) Eri silk fibre during workshop.

Inauguration of tasar silk: Longturi (Assamese Tasar silk) is a new product of Tasar silkworm available at the forest of South Kamrup area and the trial products (Fabric and Silk) were inaugurated during the workshop with the view that promotion of this will definitely help some poor people to earn their livelihood. Awareness generated through this workshop was a beginning to grow this industry in a luxuries way. It will also be a challenge for importing the inferior quality Tasar silk.

Inauguration of Tasar Silk product (Longturi)

The workshop was a grand success and it has got wide publicity trough various media like T.V., News papers etc.

Distribution of certificates

B.11.3. Workshop cum Training on Plant Diversity and Environment

A training cum workshop under the Project 'Plant Diversity and Environment Education through the Students of Assam', catalyzed and supported by NCSTC Division, Dept of Science and Technology, Govt. of India was organized at Namrup Petrochemical High School from 10th to 14th November 2008. The inauguration of the programme was held at the auditorium of Namrup club on 10th November 2009 at 2.00 p.m., which was inaugurated and presided over by Professor Joyanti Chutia, Director, IASST. As a part of the propagation of the knowledge of the plant diversity of the region and to inculcate the knowledge of the importance of study and preservation of these plants, to protect the polluted Environment from further detoriation and destruction, the programme has been organized.

In speech Prof J. Chutia insisted on the preservation of plant diversity of the region. She also requested the students community to gather knowledge from the elders about the use of medicinal plants in curing various diseases, as the natural remedies has taken a special place in the health sector. Also she stressed for organizing such programmes, which will motivate the school students for protecting, planting plants and conserving the forest and its products for future use scientifically. Dr. Jibon Kotoky, Principal coordinator of the Programme anchored the programme and welcomed the guests.

In the speech of Chief Guest Sri O.P. Tailor MD, Assam Petrochemicals Limited, expressed his happiness for holding this programme at Namrup. He advised the students of planting at least one plant and keeps the plants alive by taking care which will be a good contribution in protecting the environment. He also thanked the organizers for the model medicinal plant garden that has been started as a part of the programme at Namrup.

Keynote address was delivered by eminent taxonomist of Assam, Dr. G. Sarma, Dept. of Botany,

Inauguration of the workshop.

Gauhati University. Eminent Ayurvedic Doctor, Prof Ganesh Dev Sarma, Govt. Ayurvedic College, Guwahati . Dr G D Sharma, HOD (Retd) and Sri D. Dasgupta, GGM, APL delivered talk as guest of Honour. Some local people also participated and took active part in the programme. Six medicinal plant gardens have been developed as a part of the programme, where rare and endangered plants were provided by the organizers, and it was applauded by the people.

The Programme was graced by experts from various organizations of Assam, like Dr. S. Gogoi, AAU, Jorhat, Rajib Bora, DHSK College, Dibrugarh, Dr I. C. Barua, AAU, Jorhat etc. Vote of thanks was given by the Head Mistress of APL high school.

The students had been given hand on training of Herbarium preparation, nursery development and slide making and observation under microscope. All teachers and students took interest in developing the Garden and the seed banks, took part in collection of seed from the forests as were trained during the workshop.

View of the august gathering

The valedictory function was held on 14th. Nov. Dr. S. Khound, senior scientist of APL presided over the programme. Certificates were given by the Head mistress of APL High School.

B.12.Animal house facility

An animal house with a unique facility was established in the campus of the IASST for raising of different species of laboratory animals viz Albino rats (Wistar), Albino mice (Swiss), Guinea pigs (Duncan Hartley) and Rabbits (New Zealand white) etc.

The Animal House is registered with Committee for the Purpose of Control and Supervision of Experiments on Animals (CPCSEA), Government of India, Animal Welfare Division. At present the following animal species are being maintained.

Sl. no.	Species	No of animals
1.	Albino Mice (Swiss)	400
2.	Albino Rats (Wistar)	250
3.	Guinea pigs(Duncan Hartley)	95
4.	Rabbits(NZW)	28

List of laboratory animals

Front view of Animal House of IASST

Albino mice colony

Rat colony

B.13.Institutional Animal Ethical Committee (IAEC)

It becomes mandatory to constitute an Institutional Animal Ethical Committee for performing experiments on animals. As the Scientists of Life Sciences Division are pursuing research on various experimental animals, an Institutional Ethical Committee has been constituted with the members as specified by the CPCSEA, Govt. of India following the guidelines laid down by the Ministry.

Institutional Animal Ethical Committee (IAEC) meeting

Present Members of the IAEC, IASST

1. Prof Joyanti Chutia, Director, IASST
   Chairperson

2. Dr. Amrit Sagar Dihingia, Tinsukia, Assam. CPCESA Nominee
   Member

3. Dr.D.G.Sarma,Ex H.O.D. Deptt of Rashasastra,
   Govt. Ayurvedic College, Guwahati-14
   Member

4. Prof. Apurva Chakraborty Professor, Deptt of Pathology, College of Veterinary Sciences AAU, Guwahati-22
   Member

5. Dr. (Mrs) Dipali Devi, Assistant Professor, Life Sciences Division, IASST
   Member

6. Prof. S.K. Sharma, Former President, Assam Science Society
   Retd Prof. & Head, Deptt of Environmental Sciences
   Gauhati University-14
   Member

7. Dr. Suresh Deka, Associate Professor
   Resource Management & Environment Division, IASST
   Member

8. Dr. Rajlakshmi Devi, Assistant Professor
   Life Sciences Division, IASST
   Member

9. Dr. Jibon Kotoky, Associate Professor & H.O.D (i/c)
   Life Sciences Division, IASST
   Member Secretary

10. Dr. Heremba Bailung, Associate Professor & H.O.D (i/c)
    Material SciencesDivision, IASST
    Special Invitee for the Meeting

CPCESA Nominee inspecting the Animal House

B.14. Medicinal plant garden

A Model medicinal plant garden at IASST campus have been developed.The main objective of establishing this garden is to maintain a conservatory of not only the most common and important species of medicinal and aromatic plants which are being used in health care by the people in the rural and hilly areas of the region, but also those which are under various degrees of threats in India in general and NE Region in particular. All the plant species were authentically identified by expert taxonomists, labeled and in many cases their therapeutic values in curing different diseases are also highlighted.

Few of them are *Clerodendron colebrookianum, Clerodendron viscosum, Terminalia, chebula, Vinca rosea, Eugenia jambolana, Punica granatum, Ocimum sanctum, Cuinamomum tamala, Murrya koenigii, Pepar longum, Rauwalfia serpentina, Terminali, Arjuna, Costus speciosus, Vitex negundo, Terminalia chebula, Amla, Glycosmis pentaphylla* etc.

B.15. Departmental Seminar

Monthly seminar programme in the Life Sciences Division has been introduced since October 2008 where the Research Scholars of the Division deliver seminar lecture on a selected topic with consultation with his/her respective guide. This is on interactive platform where Research students of the division as well as from other division also may attend and intereact themselves. The following two lectures have been delivered during this period.

i) Mr Rubul saikia –"Bio- Degradable Natural Fibres: Its Prospects and Problems" on 16/10/ 2008.

ii) Mr. Bijit Talukdar- "Studies on tensile properties of natural silk fibres of North Eastern Region"on 22nd January 2009.

B. 16. Ph. D. Produced

Ms. Bula Choudhary was awarded ph. D for her thisis entitled Biofertilizer potential of A M Fungi and its dual interction with Rhizobia for enhancement of pulse production in Assam under the supuvision of Dr. P. Azad in 2008 by the Guwahati University.

B.17. Divisional manpower

Dr. Jibon Kotoky - Associate Prof and Head (i/c)
Dr. K.C.Baruah - Hony.Scientist
Dr. P. Azad Associate Professor (Retd.), On extension
Dr.Dipali Devi - Assistant Professor
Dr.Rajlakshmi Devi - Assistant Professor
Mr Rubul Saikia - Project assistant
Mr. Rupak Sarma - Project Assistant
Mr Dulal Chandra Baruah - SRF
Ms. Nasimun Nissa - SRF
Mr Kaustav Kamal Sharma - JRF
Ms. Tiluttama Mudoi - JRF
Mr Bijit Talukdar - JRF
Ms. Phulmani Choudhury - JRF
Mr. Saranga Dutta - JRF
Mr. Ramesh Nath - Teacher Fellow
Mr. Sarangapani Saikia - Teacher Fellow
Mr. Krishna Kanta Sarma - Field Assistant
Ms. Julie Bordoloi - Lab Assistant
Mr. Subrata Goswami - Lab Assistant
Mr. Bolin Das - Lab Attendant
Mr. Tarun Talukdar - Lab Attendant
Mr. Sabin Kalita - Animal keeper

C. Resource Management and Environment Division

Since its inception the Resource Management and Environment Division (RM&ED) of IASST has been pursuing intensive research work on various environment related issues of North East region of India. Major areas on which significant contribution has been made are exploration and documentation of biodiversity specially amphibians and fishes and detailed investigation of eco-biology of some of these species in four states of NE India viz. Assam, Arunachal Pradesh, Nagaland and Manipur, phyto and bioremediation of oil and heavy metal polluted soil of Upper Assam oil fields, remediation and reclamation of polluted oil field soil, and preparation of vermi-compost from wastes.

The RM&E Division has following Sections

Biodiversity section
Environmental Chemistry section
Environmental Biotechnology section

C.1. Research activities

C.1.1. Biodiversity Section

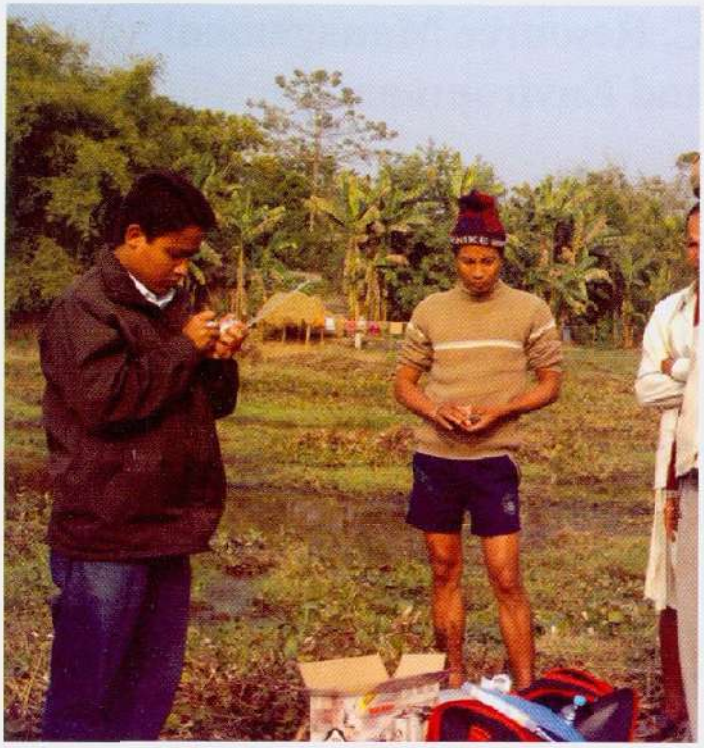
Research work is being carried out in the following fields
1. Exploration of Biodiversity in Assam, Nagaland and Arunachal Pradesh and Manipur

2. Fishery Biology and fishery Management

3. Ecobiological study of species of conservational importance.

Biodiversity Assessment of Beels

Fishery is one of the most important renewable resources that can be exploited to boost fish production in the vast water bodies of Assam. Normally beels in Assam are productive environments. At present these beels are amongst the threatened habitats due to accelerated drainage, land encroachment and over exploitation. Beels are fed by rivers and their tributaries. Some of these beels under investigation lost connection with river either due to man made or natural causes. During flood adjacent beels get flooded and faunal enrichment takes place. These beels used to contribute a major portion of the capture fishery resources of the state. In recent times most of these beels have turned into unproductive waste areas due to various climatic and anthropogenic causes.



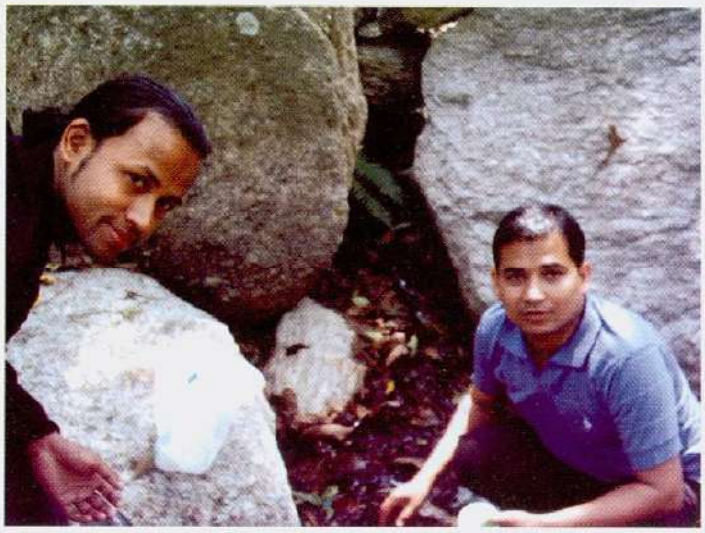
Sample collection at Bhelaimara beel

The ecological changes brought about by natural and artificial causes have adversely affected the diversity and abundance of fish species of the Beels. These include conversion of the water body to a characteristic body and radical transformation of long established ties and inter-relationships between organisms. The local stocks have been changed and other changes such as spawning grounds and feeding grounds have resulted automatically, significantly altering the ecology of the Beel which lost connection with the lotic water body. The reduction of water level results in the formation of shallow areas which impede or obstruct fish movements too.

Most of the beels are weed infested and heavily silted. Almost all beel areas are shrinking because of demand of beel area for human habitation, encroachment and for cultivation purposes. Siltation being the major cause, the beels turned into unproductive areas with extensive weed cover. These beels can be converted into culture fisheries with proper management so that it becomes a good reservoir for a variety of fishes and other aquatic organisms. And in this way the health of the ecosystem will be maintained and these will be rich source of protein as well as habitat for rare and endangered bird species.

A total of 34 beels selected by the Directorate of Fisheries, Govt of Assam were surveyed for making assessment of Biodiversity and physico chemical characteristics of soil and water.. The beels are from 12 different districts of Assam namely Golaghat, Nagaon, Dhuburi, Borpeta, Nalbari, Kokrajhar, Dibrugarh, Jorhat, Tinsukia, Dhemaji, Lakhimpur and kamrup district. Survey has been completed and detailed report of 34(thirty-four) beels has been submitted.

Study of aquatic biodiversity in all three selected watersheds of Arunachal Pradesh, India



Fish collection at Tenga valley, Arunachal pradesh

The Himalayan region not only has the expected diversity due to altitude on a North South axis but considerable longitudinal diversity over the 3500 km East-West axis as well. With physical variation from 500m to near 9000m in altitude, and from 100mm to over 6000mm precipitation, the eastern Himalayan region has been identified as one of the

Research Scholars with Supervisor in the Biodiversity lab

biodiversity hot spot regions of the world(Mayr, 1988). Arunachal Pradesh occupies a major part of Eastern Himalayan region. This region has a) The large number of endangered species present in the area. b) Biology and ecology of high altitude species is not known and there is increasingly obvious physical deterioration of the environment.

Till the end of the last century only a minute sample of this vast resource has been documented. The work to be carried out in Subansiri and West Kameng watershades will provide valuable data regarding ecological conditions and diverse faunastic groups these ecosystems are supporting.

A study on Ichthyofaunal diversity in four lotic water bodies of kamrup district, Assam and ecobiological study of two species of conservational importance.

Eastern Himalayan region abounds in numerous water bodies having diverse ecological conditions. These water bodies support numerous commercially important and ecologically important fish species. Study of my group in the last decade has revealed that many of these water bodies are in various stages of environmental degradation. Moreover many more species may have remained undiscovered in some of these water bodies.

Fish collection at Basistha, Guwahati

It is evident from our study that there is faster degradation of habitat, which will lead to decline, and loss of species. We intend to study the distribution, present status and ecobiology of some of the species in threatened /rare category.

In our preliminary survey we could record 83 fish species under 7 orders and 24 different families from the four lotic water bodies.

Ichthyofaunal diversity in two beels of Goalpara district, Assam.

Fish diversity in two beels of Goalpara district is being documented. One new record for Assam C.Montana has been published from these water bodies. More than 60 fish species has been collected identified and reported during the study period. Detailed eco-biological study of selected species is being done.

Study of faunastic diversity in hill streams of Wokha district, Nagaland, India

A torrential stream of wokha district of Nagaland has been surveyed for recording fish and Amphibian fauna. A remarkable achievement in this field during this year is publication of a new of frog genus *Leptolalax* Dubois, from India. The rare hill stream species *Ixalus lateralis*, Anderson, 1871 belonging to this genus is a new record for India. *Amblyceps apangi* Nath and Dey 1989, a rare fish species has been published from streams of wokha district of Nagaland, India.

A study on amphibian fauna in and around Loktak Lake, Manipur.

Loktak lake a ramsar site of international importance is the abode of rare flora and fauna. Areas in and around loktak lake has been surveyed for documenting amphibian diversity. Ten new records of amphibians from Manipur has been published so far. Detailed ecobiological study of a number of species is in progress.

Ixalus lateralis, Anderson, 1871 a new genus recorded from India collected by L. Nzano Humtsoe

C.1.2. Environmental Chemistry section

Contamination of Paddy field soil due to petroleum wastage activities in nearby areas of IOCL (Bongaigaon Refinery (India)

Petrochemical plants generate large quantities of effluent in the form of waste water and sludges, some of which may be considered hazardous because of the presence of toxic organics and heavy metals.The area chosen for the study is in the vicinity of Indian Oil Corporation Ltd. (Bongaigaon Refinery), formerly known as Bongaigaon Refinery and Petrochemicals Limited, (BRPL). Dhaligaon, Assam in India. BRPL has been amalgamated with Indian Oil Corporation Ltd. on 25th March, 2009

Rice grain affected by Bongaigaon Refinery effluent and flaring

A survey conducted in the nearby villages of IOCL (Bongaigaon Refinery) area revealed that the quality and productivity of the crops grown in these areas are not satisfactory to the villagers due to discharge of effluent as well as the gas flaring.

The following phases of the research work have already been completed.

- Field survey and collection of three batches of soil samples in winter and summer season.
- Analysis of the physico-chemical parameters of the soil and wastewater.

Present work concentrates on

- Analysis of the heavy metals and petroleum hydrocarbon contents of the soil and wastewater.
- Determination of some enzymatic activity of the soil samples.

Levels and speciation of heavy metals in soils of Crude oil contaminated soil of Lakowa oil field

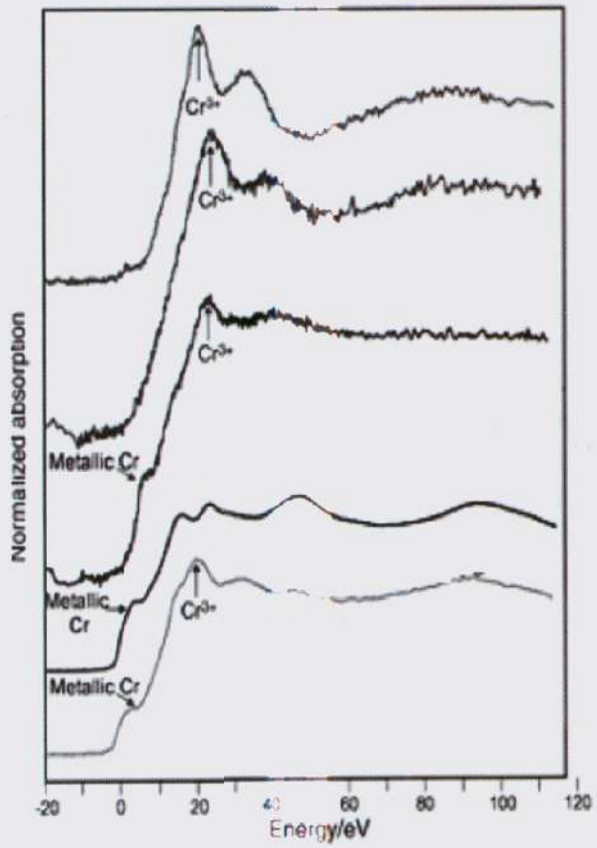
Knowledge of the total content of trace metals is not enough to fully assess the environmental impact of polluted soils. For this reason, the determination of metal species in solution is important to evaluate their behaviour in the environment and their mobilization capacity. Sequential extraction procedure was used to speciate six heavy metals (Cd, Pb, Cu, Ni, Cr and Zn) from contaminated soils of Lakowa oil field into six operationally defined geochemical species: water soluble and exchangeable, carbonates, Fe-Mn oxide, organic and residual. Metal. The highest amount of Cd (avg. 35%) in the non-residual fractions was found in the exchangeable fraction, while Cu and Zn were significantly associated with the organic fraction. Assuming that mobility and bioavailability of these metals are related to the solubility of the geochemical form of the metals, and that they decrease in the order of extraction sequence, the apparent mobility and potential bioavailability for these six metals in the soil were: Pb > Zn > Cu > Cr >Ni > Cd.

Sample collection from IOCL, Bongaigong refinery

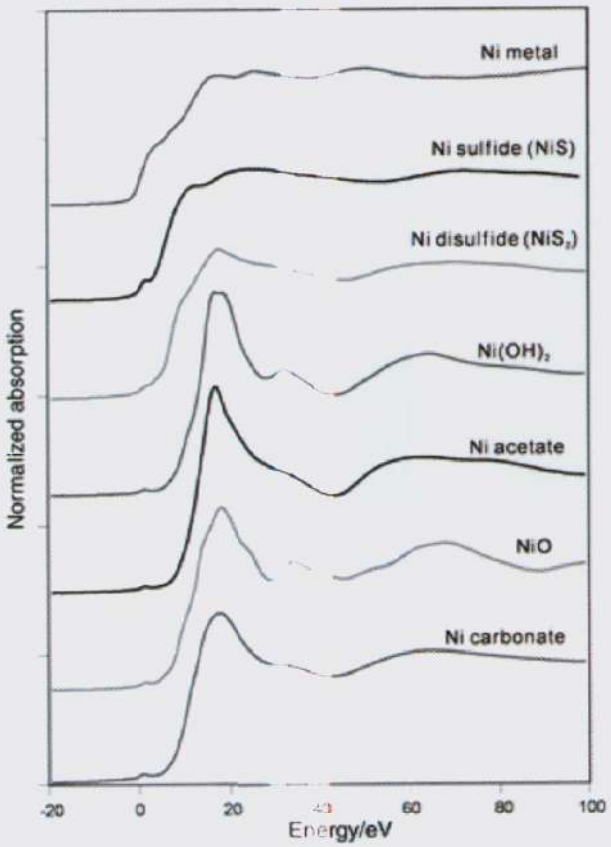
Sequential extraction techniques do not provide a direct characterization of metal speciation, but rather an indication of chemical reactivity. Despite their limitations as to the selectivity of extractants, redistribution of elements among phases during extraction, the diversity of extraction schemes and limited comparability of data.On the basis of the above study we were emphasized to identify specific oxidation states of Chromium, Nickel and toxicity of metals.For example, trivalent chromium has a low order of toxicity, while hexavalent chromium is highly toxic.Therefore, speciation studies may be required to understand the potential hazards associated with a chromium and Nickel mixture X-ray absorption fine structure (XAFS) spectroscopy was used to determine the oxidation states of chromium and nickel.

Chromium, as chromate (Cr^{6+}), can cause lung cancer, whereas chromium in the trivalent form (Cr^{3+}) is an essential nutrient element to mammals. The hexavalent form (Cr^{6+}) converts to a trivalent form. Chromium is often associated with the clay content of soil and since clay minerals are one of the major mineral groups

found in crude oil it may therefore contain chromium in this form. However, 95% of the chromium in most crude oil is in the Cr^{3+} valence state.



X-ray absorption fine structure of chromium oxidation states



X-ray absorption fine structure of nickel oxidation states

Nickel, as a major component of Crude oil and some of its compounds as probable human carcinogens Two carcinogenic nickel compounds of possible concern in crude oil contaminated soil are carbonyl [$Ni(CO)_4$] and sub-sulfide (NiS,) compounds. The oxidation states of these compounds are (0) and (II), respectively.

C.1.3. Environmental Biotechnology Section

Phytoremediation of hydrocarbon contaminated soil of Upper Assam.

Oil contaminated soil in and around exploration and spillage areas and oil refineries are still remaining a major environmental problem. The affect of oil spill has been frequently felt in the mining areas in the North Eastern Region of India. It causes noticeable damage to the environment and it is believed that this changes the chemical, physical and biological status of the soil in the vicinity. It is reported that the agricultural land near the oil exploration sites are often contaminated by hydrocarbons and land become unfit for cultivation. So, it is necessary to develop new and modern technology to restore the soil health due to contamination of hydrocarbon. Bioremediation of petroleum in soil using indigenous microorganisms has proven effective; however, the biodegradation rate of more recalcitrant and potentially toxic petroleum contaminants, such as Polycyclic Aromatic Hydrocarbons (PAHs), is rapid at first but declines quickly. Biodegradation of such compounds is limited by their strong adsorption potential and low solubility. Vegetation may play an important role in the biodegradation of toxic organic chemicals (Walton and Anderson, 1990; Lappin et al, 1985, Sandmann and Loos, 1984; Hisu and Bartha, 1979; Reddy and Sethunanthan, 1983; Anderson and Walton, 1992; Aprill and Sims, 1990; Ferro et al, 1994; Reilley et al, 1996). Plant may indirectly contribute to the dissipation of contaminants in vegetated soil. Soil adjacent to the root contains increased microbial population (Paul and Clark 1989). Rovira and Davey (1974) found the number of bacteria in the rhizosphere to be much as 20 times that normally found in non-rhizosphere soil. Short, Gram – negative rod – shaped bacteria especially Pseudomonas, Flavobacterium and Alcaligenes are most commonly found in the rhizosphere (Barber, 1984). Plant roots release exudates capable of supplying amino acids, carboxylic acids, carbohydrates, nucleic acid derivatives, growth factors, enzymes and other related compounds (Alexander, 1977).

Research Scholars at work

Aprill and Sims (1990) studied the effects of using deep-rooted prairie grasses to remediate soil contaminated with PAHs. They suggested that the roots of these perennial grasses may be more effective as stimulating the rhizosphere microflora due to their fibrous nature. Fibrous roots offer more root surface area for microbial colonization the other roots and result in a longer microbial population in the contaminated soil.

Phytoremediation is a viable remediation method for petroleum-contaminated soil. The use of vegetation for remediation of contaminated sites is attractive and eco- friendly. Keeping this in to mind, the present investigation was carried out to study the phytoremediation potentiality of some selected herbs, which are locally available for remediation of petroleum hydrocarbons from contaminated soil of oil exploration sites.

The following are the objectives of the project:

(1) To estimate extent of hydrocarbons contamination of agricultural land and of influence zones of oil processing centers.

(2) To survey sparse vegetation site contaminated with hydrocarbons for collection of plant samples (mostly herbs).

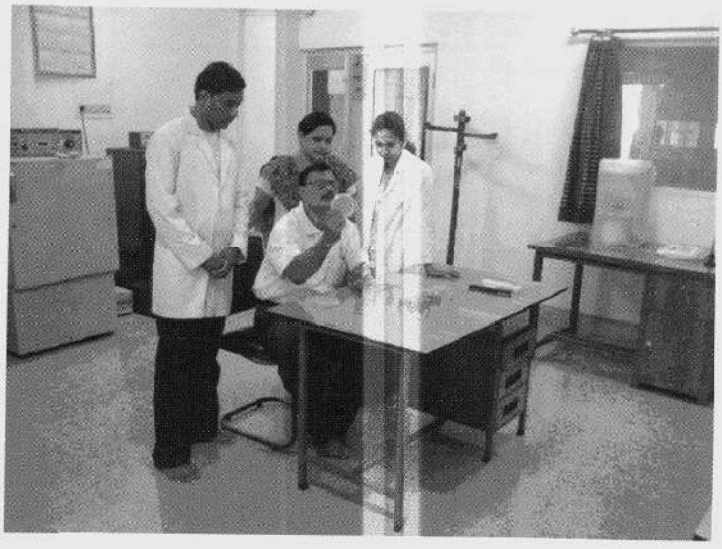
(3) To evaluate and screen the above herbs to be used as remediation of hydrocarbons.

(4) To develop a viable phytoremediation process using the screened and known hydrocarbon degrading plant species.

The soil sample collected from leakage site of oil field situated at Lakowa, Sibsagar district of Assam, India was characterized the physicochemical properties before conducting the experiment. The pH of the soil was acidic in nature (4.47), Water holding capacity was very low (16.05%) and organic carbon content was high (3.36%). The oil and grease content was found 37000 ppm. All total five plants were taken for the study out of which three were taken from th contaminated sites of Lakowa oil field on the basis o their population number and other two were take from the literature, which are locally available Dissipation of the hydrocarbon in the soil after harves of the plants was recorded. The uptake of TPH by th plants is also recorded. The uptake of TPH was found maximum in the shoot portion than root portion. A total of 11 Poly Aromatic Hydrocarbons (PAH detected in the test soil samples. Out of 11, the PAH namely - Phenanthrene, Anthracene, Fluranthene Pyrene, Benzo(A) anthracene and Benzo(A,H) anthracene were detected in the soil after harvest of the plants (i.e. six months from the initiation of the investigation), while other PAH which were present in the experimental soil sample, were not detected in the soil after harvest of the plant. The investigation is going on.

Bio-surfactants and their use for recovery of hydrocarbons from refinery sludge.

Oily sludge is the waste of refineries. It may be generated by sedimentation process in the bottom of crude oil and heavy black oil storage tanks, in sludge separator unit and in biological effluent treatment plant. Small amount of sludge may also be generated in various unit processes in a refinery.



Research Scholars with their supervisor

Guwahati refinery situated at Noonmati, Assam generates 2560m^3 of sludge per year (unpublished report of civil department, Guwahati refinery 1997). This sludge is disposed off in a land adjacent to the refinery. Disposal of the sludge generated by the refinery was not a problem in the early part of its establishment as space was not a problem during that

time. At present due to limitation of space, disposal of the refinery sludge has been creating a serious problem of environmental degradation; even it may contaminate the ground water resources in nearby areas by leachates from the disposal site (NEERI report).

The natural degradation of petroleum hydrocarbons present in sludge is a slow process and it depends on a number of environmental parameters. Extensive research is now in progress to isolate appropriate microorganisms for rapid degradation of hydrocarbons in petroleum spills and in oily sludge.

Generally, oil, water and insoluble are the main constituents of refinery sludge. 25 to 59 % oil content is present in the sludge of Guwahati refinery (Sharma et al, 1998). In the process of biodegradation, certain microorganisms produce certain chemicals, which act as natural surfactant. This surfactant destroys the adhesive property of the paraffins and solubilizes them. The process involves emulsification of the emulsion resulting in the separation of two phases-clean hydrocarbons at the top and water, inorganic, sand at the bottom. Emulsification is carried out by using a surfactant produced by the microorganisms is known as bio-surfactant and the process is called bioconversion.

Biosurfactant(s) spontaneous release and function are often related to hydrocarbon uptake; therefore, they are predominantly synthesized by hydrocarbon degrading microorganisms. Some biosurfactants however, have been reported to be produced on water-soluble compounds such as glucose, sucrose, glycerol or ethanol (Guerra – Santos, 1986; Cooper & Goldenberg, 1987; Palejwala & Desai, 1986; Passeri et al., 1992; Hommel & Huse, 1993). In some instances, these compounds have antibiotic properties, which may serve to disrupt membranes of microorganisms competing for food. Examples of these include the lipoproteins of the iturin family produced by Bacillus subtilis, which have powerful anti-fungal properties (Sandrin et al., 1990; Thimon et al., 19921), Candida antarctica, which have antmicrobial activity (Kitamoto et al., 1993) and Bacillus licheniformis, which inhibit bacteria, yeast and filamentous fungi (Fiechter, 1992a). Chemically synthesized surfactants have been used in the oil industry to aid the clean up of oil spills, as well as to enhance oil recovery from oil reservoirs. These compounds are not biodegradable and can be toxic to the environment. Biosurfactants however, have been shown in many cases to have equivalent emulsification properties and are biodegradable.Thus there is an increasing interest in the possible use of biosurfactants in mobilizing heavy crude oil transporting petroleum in pipelines, managing oil spills, oil pollution control, cleaning oil sludge from oil storage facilities, soil / sand bioremediation and microbial enhanced oil recovery.

PAH analysis in Gas Chromatograph

In the present investigation, it is proposed to isolate some appropriate and native microorganisms, which can produce surfactants for recovery of crude oil from refinery sludge. The following are the main objectives of the present investigation.

I. To screen appropriate surfactant producing microorganism (s) (namely bacteria) present in certain hydrocarbon contaminating soil of oil fields of upper Assam.

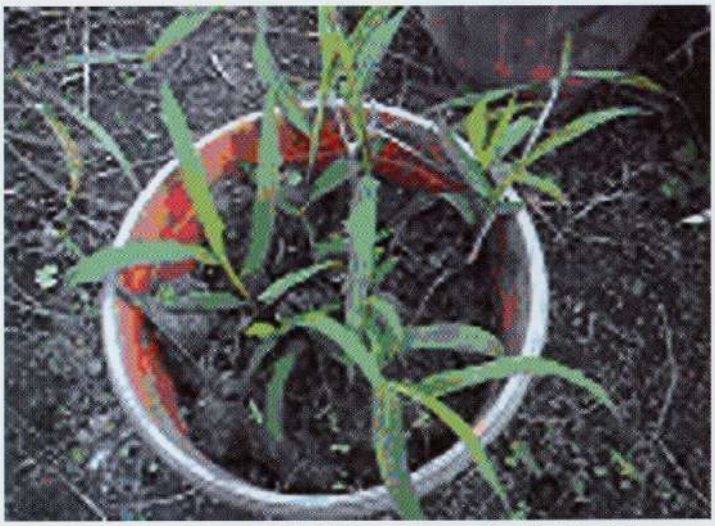
II. To study on efficiency of production of surfactant of test microorganisms.

III. To evaluate the effect of different temperatures, pH and salinity on surface tension produced by selected bacterial strains.

IV. To study on recovery of hydrocarbons from refinery sludge using the surfactant produced by the microorganisms.

During this period, soil samples were collected from hydrocarbon contaminated soil near Group Gathering Station (GGS) of Lakowa and Moran oil field situated at Sibsagar and Dibrugarh district of Assam. From the collected soil samples, a total of 28 bacterial strains have been isolated. Using glucose as a sole carbon source, the production of surface-active properties of all the isolated strains of bacteria has been tested. Out of 28 bacterial strains, 15 strains reduced surface tension in glucose media. The others investigations are going on.

Field application of Phyto and Bioremediation Technique for reducing oil contamination developed at IASST, Guwahati in collaboration with Oil india limited, Duliajan, Assam.



Plants grown at IASST net house for field trial

Oil contamination in soil in and around oil installations due to natural and manmade causes is a common phenomenon. Research is in progress all over the world to find a solution to this inherent problem. A work was undertaken at IASST to screen certain plant species which could degrade this pollution over a period of time. The associated microbes in these plants were also studied to determine their efficacy in reducing oil and heavy metal pollution of soil.

Plantation inside the Green House

remediation. Large scale propagation of selected plants has been done so that these plants can be transferred to field.

C.2. Research Projects:

C.2.1. Ongoing

Project-1. Study of aquatic biodiversity in all three selected watersheds of Arunachal Pradesh, India.
Sponsored by NRDMS Division, Department of Science and Technology, Govt.of india
Amount- 11.5 Lac
Duration- 2009-2012

Dr.Sabitry Choudhury Bordoloi- Principal Investigator
Sri Mrinal kumar Das- JRF
Sri Pinku Bora –Field assistant

Project-2. A study on Ichthyofaunal diversity in four lotic water bodies of kamrup district, Assam and ecobiological study of two species of conservational importance.
Sponsored by National Bureau of Fish genetic resources, Lucknow
Amount and duration-1.5 Lac, 2008-2009

Dr.Sabitry C. Bordoloi - Principal Investigator
Sri Budhadev Basumatari Project Assistant

Project-3. Phytoremediation of hydrocarbon contaminated soil of Upper Assam.
Sponsored by: Ministry of Environment and Forests, Govt. of India.
Amount and Duration: Rs.13.22 Lakhs,
3 years (2007-2010)
Dr. Suresh Deka- Principal Investigator
Dr. Neelotpal Sen Sarma- Co-Principal Investigator
Mr. Hemen Deka- JRF

Project-4. Title-Bio-surfactants and their use for recovery of hydrocarbons from refinery sludge.
Sponsored by: Department of Biotechnology, Govt. of India, New Delhi
Amount and duration: Rs. 27.62 Lakhs
3 years (2008-2011)

Dr. Suresh Deka- Principal Investigator
Prof. K. G. Bhattacharyya -Co-Principal Investigator
Ms. Rashmi Rekha Saikia – JRF

C.2.2. Completed

Project-1. Biodiversity Assessment of Beels under Assam Agricultural Competitiveness project (AACP). Sponsored by World Bank
Amount and duration- Rs.10 lac (2007– 2008)
Dr.S.C.Bordoloi- Principal Investigator
Ms Banita Ningombam- Project scientists
Sri Budhadev Basumatari- Project scientists
Sri Dhaneshwar Boro - Field attendent

C. 3. Publications

C. 3.1. In cited Journals

1. **L. Nzano Humtsoe, Sabitry Bordoloi, Annemarie OHLER and Alain Dubois** (2008): Rediscovery of a long known species, *Ixalus lateralis*, Anderson, 1871. ZOOTAXA **1921**, 24-34.

2. **L. Nzano Humtsoe and Sabitry Bordoloi** (2009): Study on the torrential catfish *Amblyceps apangi* Nath & Dey 1989(Teleostei: Amblyciptidae) From Wokha district, Nagaland, Journal of threatened Taxa **1**(2), 109-113.

3. **H. Deka, S. Deka and C. K. Baruah** (2008): Study on efficiency of native verms for production of Vermicompost, Environment & Ecology **26**(4), 1509-1512.

4. **U. J. Medhi, A. K. Talukdar and S. Deka** (2008): Effect of pulp and paper mill effluent on germination and seedling growth of mustered, pea and rice, Poll Res. **27**(3), 437-442.

5. **H. Deka and S. Deka** (2008): Application of vermicompost of native earthworm Perionyx sp. for cultivation of rice (Oryza sativa L.), J. Advanced Pl. Sc. **4** (1&2): 33-37.

C.3.2. Publication in Scientific Book

1. Dr. S.C.Bordoloi is one of the contributing authors in Threatened Amphibians of the world , Published by IUCN, Conservation international and LYNX edicions,1st edition July, 2008

C.4. Paper Presented in Conference/ Seminar

1. H. Deka, S. Deka and C.K.Baruah. "A study on suitability of different raw material for production of vermicompost by exotic earthworm Eudrilus eugeniae (Kinberg)." presented in the National Seminar on Environmental Issues in North East India: Past, Present and Challenges Ahead Organized by the Gargaon College, Sivasagar during May 10- 11, 2008.

2. H. Deka, S. Deka and C. K. Baruah: "Vermiconversion of wastes of sugarcane (Saccarum officinarum L.) By native earthworm Perionyx sp.)" Paper presented in the National Seminar on Biodiversity and Human welfare organized by Department of Zoology, Gauhati University in Association with Zoological Society of India held on 29-31 December 2008.

3. H. Deka, S. Deka and C. K. Baruah: "Effect of rhizosphere microflora on certain agricultural crops as influence by application of Vermicompost" presented in the National Seminar on "Exploitation, Utilization and Strategy Action Plan for Sustainable Management of Plant Resources" organized by the Department of Botany, Gauhati University, Guwahati held on February 27-28, 2009.

4. B.Basumatari, .Ningombam, A.K.Roy and Sabitry Bordoloi, "status of Certain degraded wetlands and their possible development for pisciculture" presented by Budhadev Basumatari in the 19th all India Congress of zoology, National zoology Congress seminar on "Biodiversity & Human welfare" held at Department of zoology, Gauhati University, Guwahati, Assam

5. Anjali Baishya and Sabitry Bordoloi. "Food and feeding habits of a semi-torrential loach from Garjan beel of Assam" presented in the 19th all India Congress of zoology, National Zoology Congress seminar on "Biodiversity & Human welfare" held at Department of Zoology, Gauhati University, Guwahati, Assam.

C.5. Seminers/ Conferences/ Workshop attended

1. Dr.Sabitry Bordoloi attended two day workshop on NE Bio Geo Programme sponsored by DST, Govt. of India during March 5th-6th, 2008.

2. Dr.Sabitry Bordoloi Represented IASST in the Conference organized by Confederation of Indian Industries on Geographical Indications: a need for protection and enforcement: A road show on Indo US

Initiatives and Perspectives held at Hotel landmark on 3rd September, 2008.

3. Dr. S. Deka participated in the "First training programme on Natural Resource Management & Environment" Sponsored by the Department of Science and Technology, GoI, organized by the Indian Institute of Public Administration, New Delhi held on March 2-8, 2009.

4. Mr. Hemen Deka, JRF participated in the "Workshop on Basic Statistics" organized by the Department of Statistics, Gauhati University, Guwahati held on Nov. 11-12, 2008.

5. Mr. Hemen Deka, JRF participated in the "Faculty Development Programme on SPSS" organized by SPSS South Asia and development of Statistics, Gauhati University, Guwahati.

6. Mr. Hemen Deka, JRF, participated in the International Workshop on "Agricultural Ecosystem and Sustainable Development in Brahmaputra Basin, Assam, India" organized by the Department of Geography, Gauhati University, Guwahati held on December 19-20, 2008.

7. Mr. Hemen Deka, JRF, participated in a Training Programme on "Novel and Innovative Biochemical and Molecular Tools for Characterization of Agriculturally Important Microorganisms" organized by the National Bureau of Agriculturally Imported Microorganisms, Kusmaur, Mau Nath Bhanjan, UP, India held on 12th. January to 1st. February 2009.

8. Ms. Rashmi Rekha Saikia, JRF, participated in a Training Programme on "Biochemical Tools & Technique for Plant Biodiversity and Conservation Study" organized by the North East Institute of Science and Technology (NEIST), Jorhat, Assam, held on January 19-31, 2009.

9. Ms. Rashmi Rekha Saikia, JRF, participated in the National Seminar on "Exploitation, Utilization and Strategy Action Plan for Sustainable Management of Plant Resources" organized by the Department of Botany, Gauhati University, Guwahati held on February 27-28, 2009.

10. Dr.A.Devi attended the Workshop on Ion Chromatograph held at Directorate of Forensic Science, Guwahati on 18th July, 2008.

11. Dr.A.Devi attended the Workshop on "Development and optimization of combined plant/microbe technologies for bioremediation of soils contaminated with hydrocarbons and heavy metals" jointly organized by The University of Sydney, Australia and Institute of Advanced Study in Science & Technology. Paschim Boragaon, Guwahati - 781035, Assam, India during 29th September to1st October, 2008

12. Dr. A. Devi attended the National Workshop on 'Recent trends in Polymer Science" organized by Institute of Advanced Study in Science & Technology. Paschim Boragaon, Guwahati-781035, Assam, India during 20th October to 25th October, 2008.

13. Dr. A. Devi attended Symposium-cum-training programme on developing capacity building of young scientists for carrying out basic, clinical and operational research in the field of nutrition during March 21-23, 2009 held at National Jalma Institute for Leprosy and other mycobacterial diseases, Agra (UP.)

C. 6. Research collaboration

Dr. Sabitry C. Bordoloi has collaboration with

1. Prof.Alain Dubois
Museum National d'histoire Naturelle
Professor and Director
Department de Systematique et
Evolution, Paris, France
Area of research:
Amphibian Systematics and evoloution.

2. Prof. Annemarie Ohler
Museum National d'histoire Naturelle
Department de Systematique et
Evolution, Paris, France
Area of research: Amphibian Systematics and evoloution.

3. Dr.Stephan Grosgean
Research Scientist
Museum National d'histoire Naturelle
Department de Systematique et
Evolution, Paris, France

Area of research: Amphibian Systematics and evoloution.

4. Dr.Balwant Singh
Associate professor,
University of Sydney, Australia.
Area of research: Phyto and Bioremediation of Oil and heavy metal pollution of soil in oil field

5. Dr.L.Cartwright
CEE Contracting Corporation, Australia.
Area of research: Phyto and Bioremediation of Oil and heavy metal pollution of soil in oil field

6. Sri H.C.Das
Chief, R&D, Oil India Limited, Duliajan,
Assam, India
Area of research: Phyto and Bioremediation of Oil and heavy metal pollution of soil in oil field

7. Dr. H.P. Sarma,
Department of Environmental Science,
Gauhati University, India
Area of research: Environmental Chemistry

Dr. Suresh Deka has collaboration with:

1. Professor I.M. Banat, University of Ulster, Northern Ireland, UK.
Area of research: Microbiology, Molecular Biotechnology, Biosurfactant

2. Dr. Banwari Lal. Director,
Environment and Industrial Biotechnology Division,
The Energy and Resource Institute (TERI),
New Delhi, India
Area of research: Environmental Biotechnology

3. Prof. K.G. Bhattacharyya,
Department of Chemistry, Gauhati University, India
Area of research: Environmental Chemistry, Physical Chemistry

4. Dr. A. Talukdar,Department of
Chemistry Gauhati University, India
Area of research: Environmental Chemistry

5. Dr. H.P. Sarma,
Department of Environmental Science,
Gauhati University, India
Area of research: Environmental Chemistry
6. Prof. A. Dutta,
Department of Zoology, Gauhati University, India
Area of research: Ecology, Fishery etc

Dr. Arundhuti Devi has collaboration with

1. Professor K.G. Bhattacharyya, Department of Chemistry, Gauhati University, India
Area of Research: Environmental Chemistry, Catalytic Chemistry

2. Dr. Ashwani Kumar,
Head, Environmental Biotechnology
Industrial Toxicology Research Centre
P. O. Box-80, M G Marg, Lucknow 226 001.
Area of Research: Environmental Chemistry, Environmental Biotechnology

C.7. Lecture delivered on invitation

1. Dr.Sabitry Bordoloi gave the Keynote address on the topic "Study of Amphibian biodiversity, environmental degradation and loss of habitat. in the U.G.C. sponsored National seminar on Recent Trends in biodiversity : Exploitation, conservation and management held at Gargaon College, Sivasagar, Assam.(November 15th,2008)

2. Dr. Sabitry Bordoloi delivered a Talk entitled "Phytoremediation of hydrocarbon and heavy metal contaminated soil in the upper Assam oil fields". Presented in the Indo Australia workshop held at IASST, Guwahati held during 29th September, 2008-1st October, 2008.

3. Dr. Sabitry Bordoloi delivered an invited talk on "Environmental degradation and loss of biodiversity" at Assam engineering College, Jalukbari on the occasion of celebration of National science day on 28th February, 2009

C.8. Other activity

1. Dr. Sabitry Choudhury Bordoloi selected member of IUCN Species Survival Commission (Amphibia) group. Switzerland.

2. Dr. S. Deka nominated as an Executive Committee Member of "Botanical Society of Assam".

3. Dr. Sabitry Bordoloi Chaired Technical Session III in the U.G.C. sponsored National seminar on Recent Trends in Biodiversity: Exploitation, conservation and management held at Gargaon College, Sivasagar, Assam on 15th November, 2008.

4. Dr. Sabitry Bordoloi Chaired Technical Session V at the 19th all India Congress of zoology, National zoology Congress seminar on "Biodiversity & Human welfare" held at department of zoology, Gauhati University, Guwahati, Assam during 29-31 December 2008.

C.9. Workshop/ conference organized

C.9.1. Workshop on Development and Optimization of Combined Plant/Microbe Technologies for Bioremediation of Soils Contaminated With Hydrocarbons and Heavy Metals

The workshop was awarded jointly by the Department of Biotechnology, Govt. of India and Australia India strategic Research fund, Australia. The award for the workshop was jointly given to Dr. Sabitry Choudhury Bordoloi, Associate Professor of IASST, Guwahati and Associate Professor Balwant Singh, of University of Sydney, Australia.

Prof. J Chutia Director, IASST welcoming the guests

A total of four Australian experts in the field were present in the workshop. They were Dr.Balwant Singh, Convener, Australia, Professor Alan JM Baker, University of Melbourne, Dr Naveen Bhatia, Department of Health and Ageing, Canberra, Dr. Louise Cartwright, EESI contracting Limited, Sydney.

A total of 13 resource persons from India made valuable presentations in the workshop.Prasad, Dr. Swaranjit Singh Cameotra, Prof. P M Mohan, Prof.(Mrs) Anjana Desai, Dr. Bhumi Nath Tripathi, Dr. Sanjeeb Kumar Panda, Shri H C Das, Prof. K G Bhattacharya, Dr. Nilima Saikia, Dr.Lingaraj Sahoo, Dr. Manab Deka and Dr.S.C.Bordoloi. The workshop was held at Donbosco institute, Guwahati over two days, i.e. from

Prof.K.M.Pathak, President addressing the gathering

Dr. Sabitry Bordoloi, convener (India) welcoming the guests

Dr. AJM Baker delivering inaugural address of the workshop

The inaugural function was organized on 29 September 2008 satrting at 10 am in Donbosco Auditorium. At the outset Dr Sabitry Choudhury Bordoloi, Convener outlined the objectives of the workshop. Professor Alan J M Baker, University of Melbourne in his inaugural address underlined the

some very high quality project proposals would emerge after the workshop. Professor Jayanti Chutia, Director, IASST welcomed the gathering. In her welcome address Professor Chutia expressed the hope that the workshop would go a long way in mutual collaboration between the research organizations of the two countries. Associate Professor Balwant Singh, chief guest of the function, in his speech stressed on the application of emerging techniques in the crucial zone to study the complex interaction between plant, soil and microbes. Professor K. M. Pathak in his presidential speech expressed his happiness in IASST playing a proud host to such an international workshop and hoped that it would give a tremendous boost in research to this upcoming organization. Dr. L. Sahoo, Associate Professor, IIT, Guwahati and joint convener of local organizing committtee, offered vote of thanks.

A view of the audience during inaugural function

The first day's presentations were related to Bioremediation of Heavy metals and the Second day's presentations were related to hydrocarbon remediation. There were three sessions each of the two days. During two days deleberations important recommendations were compiled so that Phyto and bioremediation research can emerge as an effective tool for reducing hydrocarbon contamination in India.

Participants of the workshop

The workshop ended with visit to laboratories of IASST followed by cultural function at IASST auditorium.Oil field visit was organized for Australian scientists at Oil india Limited, Digboi, Assam on 1st of October, 2008.

C.9.1. Celebration of World Environment Day and 2008 Year of Frog

Amphibian decline has been recorded in many countries of the world. In order to create awareness and implementing conservation measures the association of zoos and aquarium (WAZA), the IUCN amphibian specialist group, the amphibian network of South Asia, ANSA etc. have decided to observe 2008 as YEAR OF FROG. The amphibians are notable nature's indicators and also provide early warning system for environmental troubles. In short they are the first kind of animals to be affected by problems in the environment.

Prof. Joyanti Chutia, Director, IASST welcoming the guests

As a part of the celebration of "2008, year of frog" in different parts of the country, Institute of advanced Study in science and technology (IASST), a leading institute involved in Exploration and Study of Biodiversity in the North eastern region of India initiated the celebration with a talk by Prof. Annemarie Ohler ,Professor and Curator of Reptiles & Amphibians, Museum National D'Histoire naturelle, 25 RUE CUVIER,Paris,France , who is one of the leading amphibian taxonomists of the world,

on 9th January,2008.The title of her presentation was on "STUDIES on FROGS". Prof. Ohler covered a wide range of topics viz. Systematics and taxonomy of Asian and African amphibians, Behaviour of amphibians and Nomenclature, methodologies used in taxonomy, Ecology, distribution and breeding behavior of selected species of frogs were dealt with at length.

Next in the series of lectures was organized on 5th June, 2008 at IASST auditorium. First lecture was delivered by Prof Annemarie OHLER on "Frog Diversity and Conservation". Prof. Ohler covered the conservation effort in different parts of the world and highlighted important amphibian species recorded along with their habitats. Second lecture on same day entitled "Tadpoles and Taxonomy" was delivered by Dr.Stephan GROSJEAN,Post Doctoral Scholar and an expert on tadpole studies from Museum National D'Histoire Naturelle, 25 RUE CUVIER,PARIS, FRANCE .He discussed at length modern methods for studying tadpoles. It was an interesting experience for the participants exchanging their views and discussions were made and expressed their good feelings about the lecture session which was arranged as a part of the "Year of Frog" celebration 2008.

Prof. Annemarie Ohler of MNHN, delivering lecture at IASST auditorium on 5th June,2008

Dr. Stephane Grosjean delivering the lecture

C.10. Divisional manpower

Dr. (Mrs) Sabitry Choudhury Bordoloi
Associate Professor and Head (i/c)

Dr.Suresh Deka
Associate Professor

Dr. (Mrs.) Arundhuti Devi
Assistant Professor

Mrs. Aparna Dutta
Assistant Professor

Sri Budhadev Basumatari
Project Scientist

Mr. Hemen Deka - JRF

Ms. Rashmi Rekha Saikia - JRF

Sri Mrinal Kumar Das - JRF

Ms Banita Ningombam -
Project Scientist

Ms Tutul Bortamulee -
Teacher Fellow

Sri Manmohan Huzuri -
Laboratory Technician

Sri Madan Kalita -
Laboratory attendant

Sri Pinku Bora -
Field assistant
Sri Dhaneshwar Boro -
Field attandant

D. Mathematical Sciences Division

The mathematical sciences division is engaged in basic as well as database research work. At present the pure mathematics research group is concerned with the problems of sequence spaces and series (crisp and fuzzy), summability theory and functional analysis. The applied mathematics group is concerned with the problems of theoretical plasma physics. The statistics group is carrying out the problems of applied stochastic process and that of distribution theory. In computer science the problems on image processing are handled. At present data is collected on the problems of economically backward women of Kamrp district of Assam.

D.1. Research activities

D.1.1 Pure Mathematics (Sequence Spaces, Series, Summability Theory)

Pure Mathematics (Sequence Spaces, Series, Summability Theory)

Throughout w, ℓ_∞, c, c_0, ℓ_p will denote the classes of all, bounded, convergent summable sequences of real or complex terms respectively. Similarly w, $_2\ell_\infty$, $_2c$, $_2c_0$, $_2\ell_p$, $_2\varphi$, $_2bv$, $_2bv_0$ will denote the all, bounded, convergent, null and p-absolutely summable, finite, bounded variation, bounded variation as well as null double sequences of real or complex terms respectively. Similar representations will be there for the sequences of fuzzy numbers for single and double sequences respectively.

Some Sequence Spaces on Ideal Convergence: Let X be a non-empty set. Then a non-empty class $I \subseteq 2^X$ (power set of X) is called an ideal if I is additive, i.e. $A, B \in I \Rightarrow A \cup B \in I$ and hereditary , i.e. $A \in I$ and $B \subseteq A \Rightarrow B \in I$.

(a) Let $\lambda = (\lambda_k)$ be a non zero scalars. Then for E a sequence space we have defined the multiplier sequence space $E(\Lambda)$, associated with the multiplier sequence Λ by,

$$E(\Lambda) = \{(x_k) \in w : (\lambda_k x_k) \in E\}$$

Different algebraic and topological properties of the sequence spaces $c^I(\Lambda)$, $c_0^I(\Lambda)$, $m^I(\Lambda)$ and $m_0^I(\Lambda)$ have been examined. The multiplier problem $(\lambda_k) \in M(c_0^I, c_0^I) = M(m_0^I, m_0^I)$ " if and only if $(\lambda_k) \in \ell_\infty^I$ " is established.

(b) I-limit superior and I-limit inferior , I-cluster point for triple sequences have been introduced and studied in detail from different aspects .

(c) Different metric space properties of the I-convergent sequences of fuzzy real numbers relative to crisp set type metric like completeness, solid, symmetric etc have been investigated.

Duals of Double Sequence Spaces: Let E be a subset of 2^w. then for $r \neq 1$ then n-dual of E is defined as ,

$$E^\eta = \left\{ \langle b_{nk} \rangle \in {}_2w : \sum_{m=1}^{\infty} \sum_{n=1}^{\infty} |a_{mn} b_{mn}|^r < \infty, \text{for all} \langle a_{mn} \rangle \in E \right\}$$

On taking r =1, we will get the α-dual, i.e. Köthe-Toeplitz dual of E. It is proved that,

$$({}_2l_r)^\eta = {}_2l_\infty, ({}_2l_\infty)^\eta = {}_2l_r, ({}_2c^R)^\eta = ({}_2c_0^R)^\eta = {}_2l_r = ({}_2c \cap {}_2l_\infty)^\eta = ({}_2c_0 \cap {}_2l_\infty)^\eta$$

$$({}_2bv)^\eta = ({}_2bv_0)^\eta = {}_2l_r = ({}_2\sigma)^\eta, ({}_2w)^\eta = {}_2\varphi, ({}_2\varphi)^\eta = {}_2w$$

Thus the spaces ${}_2l_r$, ${}_2l_\infty$, ${}_2w$, ${}_2\phi$ are n -perfect spaces.

Sequence Spaces Associated with Multiplier Sequences: Let $\Lambda = (\lambda_k)$ be a sequence of non-zero scalars. Let $p = (p_k)$ be a sequence of positive real numbers with $t_k = pk^{-1}$, for all $k \in \mathbf{N}$. Let . Let $M = \max\left\{1, \sup_k p_k\right\}$ E_k be seminormed spaces, semi normed by f_k, for all $k \in N$ then the following sequence spaces have been introduced,

$$\ell(E_k, \Lambda, p) = \left\{ (x_k) : x_k \in E_k, \text{for all } k \in N \text{ and } \sum_k \left(f_k(\lambda_k x_k)\right)^{p_k} < \infty \right\}$$

$$\ell\{E_k, \Lambda, p\} = \left\{ (x_k) : x_k \in E_k, \text{for all } k \in N \text{ and } \exists r > 0, \text{such that } \sum_k \left\{f_k(\lambda_k x_k r)\right\}^{R} t_k < \infty \right\}$$

It is shown that $\ell\{E_k, \Lambda, p\}$ is a complete paranormed space, paranormed by,

$$h(x) = \left[\sum_{k=1}^{\infty} \left(f_k\left(r \lambda_k x_k p_k^{-t_k}\right) \right)^{p_k} \right]^{\frac{1}{M}}$$

whenever E_k's are complete semi normed spaces.

Different algebraic and topological properties like solid, monotone, symmetric, separability etc. of these spaces have been examined. Some inclusion results have been obtained. The multiplier theorem has been established.

Difference Sequence Spaces: Let $\Lambda=(\lambda_k)$ be a non-decreasing sequence of positive real numbers tending to infinity and $\lambda_1=1$ and $\lambda_{i+1} \leq \lambda_i+1$, for all $i \in N$. Let $I_i = [i-\lambda_i + 1, i]$, for all $i \in N$. Let E be a semi normed space, semi normed by q. let $A = (a_{nk})$ be a non negative matrix such that $\|A\| = \sup_n \sum_{k=1}^{\infty} a_{nk} < \infty$. Let f be a modulus, $p = (p_k)$ be a sequence of positive real numbers and r, $m \in N$ be fixed. Then we define,

$$[V_\lambda^E, A, \Delta_m^r, f, p] = \left\{x \in w(E): \lim_{i\to\infty} \frac{1}{\lambda_i} \sum_{k \in I_i} a_{nk} \left[f\left(q\left(\Delta_m^r x_k - L\right)\right)\right]^{p_k} = 0, \text{uniformly in } n, \text{for some } L \in E\right\}$$

Similarly null and bounded type sequence spaces have been introduced. These spaces generalize and unify many existing sequence spaces. Different algebraic and topological properties of these spaces have been investigated. Some inclusion results have been obtained for different parameters.

Difference Sequences of Fuzzy Real Numbers: The classes of sequences of fuzzy real numbers of usual convergence and statistical convergence have been studied. Different types of metric and algebraic properties have been investigated. The main observation during the course of investigations is "For a crisp set case, $x_k \to L$ implies $\Delta x_k \to 0$, $k \to \infty$. . for the fuzzy set case, $X_k \to L$ implies $\Delta X_k \to Z$, where the area of the curve bounded by Z and the real line is double the area bounded by L and the real line.

Some Double Sequence Spaces:

(a) Let M be an Orlicz function, $\mathbf{p} = (p_{ij})$ be a double sequence of positive real numbers. Then we have introduced.

$$_2W(\Delta, \Delta, \rho) = \left\{(a_{ij}) \in {}_2w: \lim_{m,n\to\infty} \frac{1}{mn} \sum_{i=1}^{m} \sum_{j=1}^{n} \left[M\left(\left|\frac{\Delta a_{ij} - L}{\rho}\right|\right)\right]^{p_{ij}} = 0, \text{for some } \rho > 0 \text{ and } L\right\}$$

Similarly, $_2W_0(M, \Delta, p)$ and $_2W_\infty(M, \Delta, p)$, i.e. null and bounded Cesàro summable difference double sequences defined by Orlicz function have been introduced, where $\Delta a_{ij} = a_{ij} - a_{i+1,j} - a_{i,j+1} + a_{i+1,j+1}$, , for all $i, j \in N$.

Different algebraic and topological properties of these sequence spaces have been investigated. Different types of inclusion results have been proved.

(b) Different properties of the double entire sequences, i.e. the class of sequences $\Gamma^2 = \left\{(a_{nk}): \lim_{n,k\to\infty} |a_{nk}|^{\frac{1}{n+k}} = 0\right\}$ have been studied in detail.

c) Let M be an Orlicz function, (X, q) be a semi normed space and (pnk) be a sequence of positive real numbers. We have introduced the sequence space,

$$_2c(M, \Delta, p, q) = \left\{(a_{nk}) \in {}_2w(q): \left[M\left(q\left(\frac{\Delta a_{nk} - L}{\rho}\right)\right)\right]^{p_{nk}} \to 0, \text{as } n, k \to \infty, \text{for some } \rho > 0 \text{ and } L \in X\right\}$$

Similarly $_2l_\infty(M, \Delta, p, q)$ $_2c_0(M, \Delta, p, q)$ i.e. bounded and null type sequence spaces have also been defined. Also regularly convergent and other type of related double sequences have been introduced. The algebraic and topological properties of these spaces have been investigated in detail. Some inclusion results have been investigated.

(d) The notion of statistically convergent difference double sequence space have been introduced. Some of their algebraic and topological properties have been investigated in detail.

(e) The notion difference double sequences of fuzzy real numbers has been introduced. Their different properties have been investigated. The differences between crisp set case and fuzzy set case have been studied in detail by providing suitable examples.

Some Sequence Defined by Orlicz Functions:

(a) Let $p = (p_k)$ be a sequence of positive real numbers, (X, q) a semi normed space and M be an Orlicz function. Let $m \geq 0$ be an integer. Then we define,

$$l_M(\Delta^m, p, q, s) = \left\{(x_k) \in w(X): \sum_{k=1}^{\infty} k^{-s} \left[M\left(q\left(\frac{\Delta^m x_k}{\rho}\right)\right)\right]^{p_k} < \infty, s \geq 0, \rho > 0\right\}$$

Different algebraic and topological properties of this space have been investigated in detail. Some inclusion results have also been established.

(b) Let $\bar{d}$ be a metric on $R(I)$, i.e. the class of normal, convex and upper semi-continuous fuzzy real numbers. Let M be an Orlicz function. Then we define,

$$c_F(M)=\left\{(X_k):\lim_{k\to\infty}M\left(\frac{\bar{d}(X_k,L)}{\rho}\right)=0,\text{ for some }\rho>0\text{ and }L\in R(l)\right\}$$

Similarly, $(l_\infty)_F(M)$ and $(c_0)_F(M)$ have been defined. Different metric space properties of these spaces have been investigated, like completeness, solid, symmetric etc.

(c) let $\wp_s$ be the class of all subsets of N those do not contain more than s elements. Let $\{\phi_n\}$ be a non-decreasing sequence of positive real numbers such that $n\phi_{n+1}\leq(n+1)\phi_n$, for all $n\in N$. let m, n be non-negative integers. Then we define,

$$m\left(M,\varphi,\Delta_m^n,p\right)^F=\left\{X=(X_k):\sup_{s\in\mathbb{N}}\frac{1}{\varphi_s}\sum_{k\in\wp_s}\left(M\left(\frac{\bar{d}\left(\Delta_m^nX_k,\bar{0}\right)}{\rho}\right)\right)^p<\infty,\ \text{for some }\rho>0\right\}$$

for $0<p<\infty$. It is shown that $m\left(M,\varphi,\Delta_m^n,p\right)^F$ is a complete metric space. Its different metric space properties have been investigated. The relationship between $m\left(M,\varphi,\Delta_m^n,p\right)^F$ and $l_p\left(M,\Delta_m^n\right)^F$ is established. Some inclusion results have also been established.

D.1.2. Statistics

a. Applied Stochastic Process

Queueing theory is a branch of Applied Stochastic Process. Its progress and development both in methodology and in applications are ever growing. As a result of which it is an important area of current research. In this context, some important contributions have been made on different branches of queueing theory as given below.

Work done on Vacation Models:

Vacation models are characterized by the fact that the idle time of the server may be used for other secondary jobs, for instance to serve the customers in other systems. Allowing server to take vacations makes the queueing models more realistic and flexible in studying real world queueing situations. One of the most remarkable results is associated with these types of models is "Stochastic decomposition result", which allows the system's behavior to be analyzed by considering separately the distribution of system (queue) size with no vacation and additional system size due to vacation. This important result was first established by Fuhrmann and Cooper[# Operations Research, 35 (1985), 1117-1129 #] for *M/G/1* type of queue with generalized vacation policies that includes both exhaustive as well as non exhaustive services. Shantikumar [# Operations Research, 36(1988), 566-569 #] relaxes some of the assumptions considered by Fuhrmann and Cooper (1985). Harris and Marchal [#Operations Research, 36 (1988), 562-565 #] extended Fuhrmann and Cooper's result to the state dependent case. In this context, more recently Choudhury [#Quality Technology and Quantitative Management, 5(2008), 33-49 #] provided simple proof for type of queue with two phases of service and generalized vacations. Further, we developed a recursive scheme for computation of limiting probabilities. Some statistical inference related issues have also been discussed to justify the existence of such types of models in real life situations.

Bernoulli vacation model is one of the important vacation model with non-exhaustive service : The classical vacation scheme with Bernoulli schedule discipline was introduced and studied by Keilson and Servi [# Journal of Applied Probability, 23(1986), 790-802 #]. In their model of , a single channel goes on vacation when the system becomes empty. The server keeps taking vacations until at least one unit is present in the system upon completion of a vacation period. If on service completion the system is not empty, the server goes on vacation with probability and resume service with probability . Madan and Choudhury [# Sankhya, 66(2004),175 -193 #] introduced a new class of Bernoulli vacation model in which all arriving batches are not allowed in to the system at all time. In this context Choudhury [# Statistical Methodology, 5(2008), 21-29 #] investigate such type of model by introducing the concept of a setup time, where the service of the first unit at the commencement of easy busy period is proceeded by a warm up period called setup time, on completion of which service starts. Our investigations include stationary queue size distributions at different points of time.

Work done on Retrial Models:

Retrial queues are characterized by the following feature that a customer who finds the server busy upon arrival is obliged to leave the service area to repeat his demand after some random amount of time called retrial time. Between trials, the blocked customer joins a pool of unsatisfied group of customers called "orbit" or "retrial group". The pioneering studies of retrial queues are to present the concept of retrial time as an alternative to the classical model of telephone systems. In this context each block customer

generates a stream of repeated requests independently of the rest customers in the retrial group. Thus, in the so called classical retrial policy, the interval between successive repeated attempts are exponentially distributed with rate (say), when the number of customers in the retrial group (orbit) is 'n'. This type of model has been studied by Yang and Templeton [# QUESTA, 2 (1987), 201-233 #] and Falin [# QUESTA, 7(1990), 127 – 168. #] . Recently, Wang et. al [# QUESTA, 8(2001), 363 – 380 #] studied a repairable retrial queueing model from the view point of reliability viewpoint for first time, both the queueing indices and reliability characteristics are obtained. In this context, Choudhury and Deka [# Performance Evaluation, 65 (2008), 714 – 724 #] generalized the above model for the case of an retrial queue with two phases of service subject to server breakdown and repair. Our investigation includes stationary distribution of the state of the server and number of customers in the orbit. Further, some important performance measures and some reliability indices are also obtained.

Artalejo and Gomez-Corral [# Journal of Applied Probability, 34 (1997), 223-233 #] introduced a more general kind of retrial policy by incorporating both possibilities by assuming that when there are n customers in the system the time intervals between successive repeated attempts are exponentially distributed random variable with parameter , where can be considered as the retrial rate per customer and the rate at which the server seeks service for customer whenever he is idle and denotes Kronecker's delta function. Such type of policy is known as linear retrial policy. In this context recently Choudhury [# Applied Mathematical Modeling, 32(2008), 2480 – 2489 #] extended this type of model for two phases of service under Bernoulli vacation schedule. Our investigation includes the embedded Markov chain at a departure epoch, orbit size distribution and joint distribution of the server state and number in the orbit. Further, we have developed a recursive scheme for computation of limiting probabilities.

b. Distribution Theory

Estimation of Parameters of Pearsonian Type VII Distribution by Scoring Method:

The method of maximum likelihood has been used to estimate parameters for Type VII of Pearsonian system of distribution curves.

The form of the distribution function for Type VII is

$$y = y_0\left(1+\frac{x^2}{a^2}\right)^{-m}, \quad -a \le x \le a$$

where

$$y_0 = \frac{N\Gamma(m)}{a\sqrt{\pi}\,\Gamma(m-\frac{1}{2})}$$

Finally the estimators are used to graduate data to te the goodness of fit. Computer algorithms have be generated and numerical computations based on da available from selected papers have been supplie The results have been compared with values obtain by using method of moments.

We conclude that the fitting of Pearsonian Syste of Curves using the scoring method of Method Maximum Likelihood yields results which are bet than the usual Method of Moments. Many use distributions and families of distributions are Pearsonian type families. Hence the results ha broad applications. These methods were tested only the above mentioned type, which is in comm use in actuarial sciences etc. The method may be us for fitting data for the other types in the mann adopted in this paper.

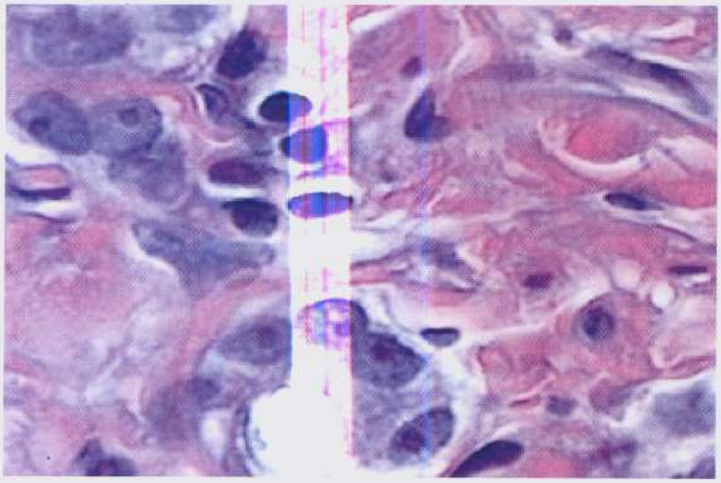
c. Computational Image Processing

Studies on some pattern recognition and machi learning methods related to cancer data and developm of algorithm based on Pearsonian system of curv Pattern recognition (PR) and Machine Learning (M can be viewed as an attempt to automate parts of the D Analysis methods.

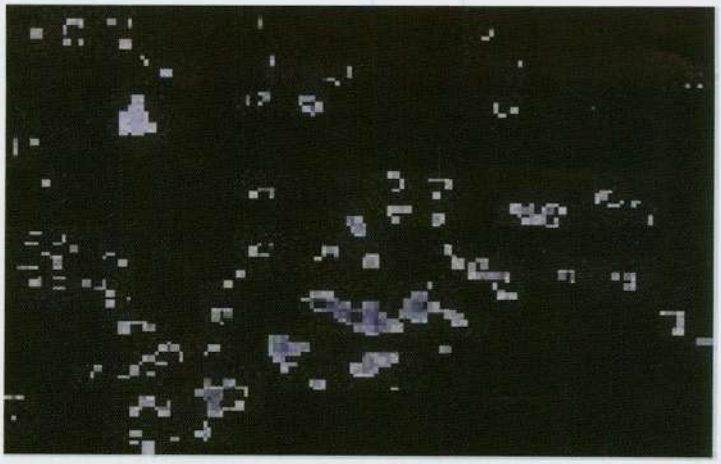
Some PR and ML methods are studied and some them are used to analysis the data related to cancerso to develop an expert system or an automated diagno system. The methods studied are Fuzzy mathemati approach, Bayesian approach and Pearsonian system curves.

Our study involves data regarding breast and cer cancer. According to reports provided by Dr. B. Baru Cancer Research Institute, the rate of breast and cer cancer in North Eastern region is quite high. The repo of the year 2002- 2004 reveals that 17% females ha breast cancer and 19.69% have cervix cancer.

These images are processed using MATLAB and Image Processing Toolbox. Some basic operations done on these images. We have done segmentation, ed detection and shape detection/analysis of some ima based on the documentation provided by the patholo and radiologist.

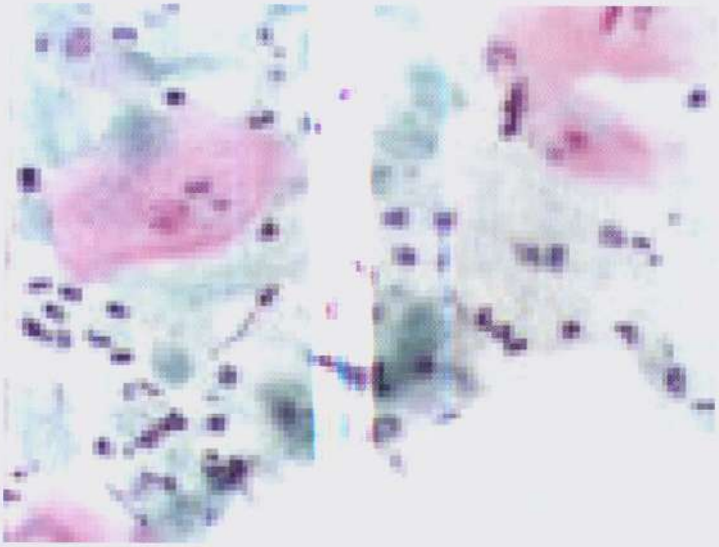


Original image of PAP.



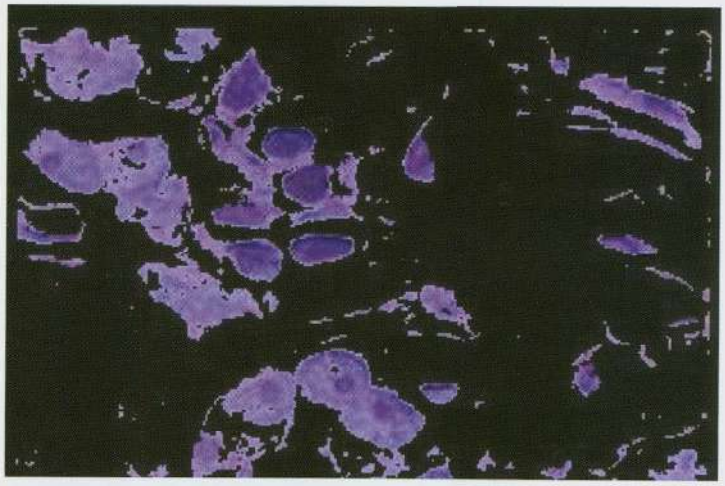
Segmented image of PAP showing only the nuclei.

Some biopsy and PAP test images of both breast and cervix are segmented and the portions containing only the nucleons are obtained. The reason for this is that the nucleus part provides better conclusive facts than the other parts the cell. The results are given below



Original image of biopsy

The mammogram images show the calcification area of the breast but it is sometime very difficult to distinguish between the calcified and non calcified area with visual inspection. So we apply Canny's Edge detection method to the mammogram. It outlines the effected area. The results are given below



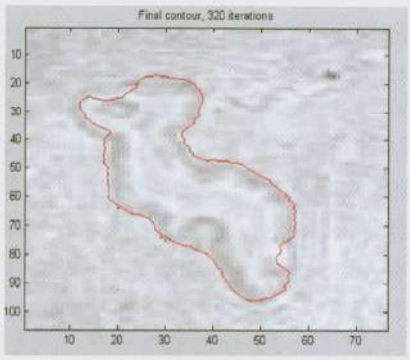
Segmented image of biopsy showing only the nuclei.

Shape is important modality to identify cancerous cells. Normal cells are almost round in shape and when they become cancerous this roundness decreases. So we have done shape analysis on some biopsy images of cervix.

Original Mammogram

Outline of the calcified area

Biopsy of cervix



Shape detection of the elongated cancerous Cell

D.1.3. Theoretical Plasma Physics

The goal of ongoing research programme is to study the nonlinear waves as the observations could have many important applications in astrophysical problems. The study has the potentiality from the applications point of view in bridging between theory and experiments as well as with satellite observations. The basic research includes to know the dynamics of levitated dust grains into the dynamics of nonlinear waves yielding sheath formation, soliton dynamics in astrophysical problems around the surfaces of Moons, asteroids, in interplanetary space, cosmic dusty environments (such as in supernova, Saturn's rings), and demanding day by day much more attention to highlight applications of plasma studies in technologies and astrophysical problems and those lead uneven competition between theory and experiments.

Our interest is to take up ideal formulation in astroplasma problems and analyze the environmental effects in space along with interest to know the formation of nebulon: the dust cloudlike structures on the surfaces of celestial bodies. The study hopes to have the future to the quest in space experiments. The study is the most fast ever growing research areas in understanding the basic properties of plasmas in laboratory as for using in industrial plasma technology and revealing many inherent properties of interplanetary spaces and its surrounding atmospheres. The dust levitation in space encourages estimating the dust sizes, forces causeway could be interesting to evaluate the crystallization of dust atmospheres around the Moon's surfaces, in milky way as well as in other interplanetary spaces. Because of which research area becomes current interest for new findings and spurred the ongoing interest in dusty plasma with a view to know the agreeable observations between theory and observations in spaces by man made satellite.

However, research works so far done is based on mathematical and computational stimulation employed to plasma waves and extended the study to the nonlinear wave through the derivation of Korteweg-deVries(K-dV) equation, Sagdeev potential(S-P) equation, K-P equation, KdV-ZK equation etc., with a view to establish the correlation between the theory and experiments as well as with satellite observations. The overall observations established some turning and heuristic features on the evolution of spiky, explosion, collapses in plasma-acoustic waves and radiation in solar flare. Some new mathematical approaches have been established to solve the complexity of the problems. Scholars have been working on nonlinear phenomena of solitons of different kinds dynamics with the interest to find the collapses of other astrophysical problems.

Further study on sheath formation in fully ionized dusty plasmas is our ongoing research interest. Based on such studies, future interests on following aspects:

(a) First interest is to derive the nonlinear wave equation which will be the basic tool to study the properties of nonlinear wave as to describe the inherent features in astroplasma dynamics.

(i) Works will be with plasma embedded by an uniform applied magnetic field.

(ii) The effect of embedded magnetic field is to further to setup the governing equations and develop to describe self consistently nonlinear behavior of the unstable oscillations and their correlation with the driving sources for differential equation.

(b) Again work will be continued with plasma contaminated by the ubiquitous nature of dust grains which will evaluate all together different nature on observations. The method development will solve for the characteristics behaviors of dust sizes to be stable and the net forces generated on it. The analysis on net forces enables to estimate the different dust grains sustain stability in different position as a result of which the creation of dust atmosphere will be investigated thoroughly.

Basic concept on the evolution of nonlinear plasma-acoustic waves will be considered in astroplasma configurations and develop to find plasma sheath to explain inherent features especially to explain its nature in spaces. Later, the charging equation (with the consideration of varying dust charges in plasmas) will derive the dust potential along with the plasma potential. Finally the equation of motion under the balance of gravity force lead to find the stability of dust grains causeway estimation of dust sizes, net force generate on dust charges will be done as a result of which, study will find the nebulon formation i.e the formation of dust clouds in milky way, around the Moons' surfaces as well as in interplanetary spaces.

Next it has been realized, certain special features of nonlinear waves; such as soliton dynamics, double layers, shock-like structures, collapse and explosion of solitons and soliton radiation etc. will also be derived. Latter study will be augmented to know the dynamics of dust levitated into the dynamical system. It is important as the levitation of dust charged grains plays the role to form the nebulon i.e. dust cloudlike

structure observable in astrophysical problems and works will be carried with a thoughtful choice of numerics to explain the new findings.

Finally our study will carry with symbolic computation with some typical numerics of astroplasmas to predict agreeable knowledge for future experiments. Totality is to find the dust sizes, dust potential, forces on it causeway lead to find the stable dust atmosphere and its position in spaces. The study expects much more applications and provoking the observations to relate with those in Saturn's ring, dust cloud on the surfaces of Moons and astroid as well as in cosmic dusty plasma environments (such as in the supernova, Milky way etc).

D.2. Research Projects

D.2.1 Ongoing

Project-1. Studies on Some Pattern Recognition and Machine Learning Models with Application to real life problems related to cancer data and development of algorithms based on Pearsonian system of curves.
Sponsored by DST (GoI),
Amount and duration- Rs. 11.57 lakhs,
2008-2011
Dr. Lipi B. Mahanta- Principal Investigator.
Prof. Dilip C. Nath- Co- Principal Investigator.
Prof. Dwijesh DuttaMajumder- Advisor.
Mr. Chandan Kumar Nath- JRF

Project-2. Study on the Coherent Structure of Dust-ion-acoustic Nebulons in the interstellar space Plasma as well as on the surface of moon and rotating stars.
Sponsored by ISRO-RESPONS,
Amount and duration– Rs. 14.31 lakhs,
2008-2011
Professor Ganesh Chandra Das.- Principal Investigator.
Ms. Rupa Chakraborty- JRF

D.2.2.Completed

Project-1. Fuzzy Real-Valued I-convergent Sequences.
Sponsored by C.S.I.R.,
Amount and duration- Rs.6.68 lakhs,
2005-2008
Dr. Binod Chandra Tripathy, Principal Investigator.
Dr. Amar Jyoti Dutta-SRF (Extended)

Project-2. Studies on Some Retrial Models with Two Phases of Service.
Sponsored by DST (GoI),
Amount and duration: - Rs.7.9 lakhs,
2006 to 2009
Dr. Gautam Choudhury- Principal Investigator.
Dr. S. Kalita- Co- Principal Investigator.
Mr. K. Deka- JRF

D.3. Publications

D.3.1. In cited Journal

1. **Lipi B. Mahanta and D.C.Nath** (2009): Estimation of parameters of Pearsonian Type VII distribution by scoring method, Journal of Statistical Sciences **1**(1), 9-18.

2. **G.Choudhury** (2008): A Single server queueing system with two phase of service and vacation, Quality Technology and Quantitative Management **5**, 33-49.

3. **G.Choudhury** (2008): A note on queue with a random setup time under restricted admissibility policy with Bernoulli vacation schedule, Statistical Methodology **5**, 21-29.

4. **G.Choudhury** (2008): Steady state analysis of an retrial queue with linear retrial policy and two phase of service under Bernoulli vacation schedule, Applied Mathematical Modelling **32**, 2480-2489.

5. **G.Choudhury and K. Deka (2008)**: An retrial queueing system with two phases of service subject to server breakdown and repair, Performance Evaluation **65**,714-724.

6. **R. Gogoi, N. Devi and G. C. Das** (2008): Small amplitude solitary waves propagating in a plasma with negative ions, Ind. J. of Pure & Appl Phys. **46**, 621-628.

7. **B.C. Tripathy and B. Sarma** (2008): Statistically convergent difference double sequence spaces, Acta Mathematica Sinica **24**(5), 737-742.

8. **A. Sahiner and B.C. Tripathy** (2008): Some I-related properties of triple sequences, Selcuk. Journal of Applied Mathematics **9**(29) 18.

9. B.C. Tripathy and M. Sen (2008): On fuzzy real-valued I-convergent sequences, Journal of Fuzzy Mathematics **16**(1) 91-99.

10. B.C. Tripathy and A. J. Dutta (2008): On fuzzy real-valued double difference sequence spaces, Journal of Fuzzy Mathematics **16**(1) 101-107.

11. B.C. Tripathy and S. Borgohain (2008): The sequence space $m\ (\phi,\Delta_m,p)^F$; Fasciculi Mathematici **39**,87-96.

12. B.C. Tripathy and P. C. Das (2008): Statistically convergent difference sequences of fuzzy real numbers, Fasciculi Mathematici **39**, 97-112.

13. B.C. Tripathy and B. Sarma (2008): Some paranormed difference double sequence spaces defined by Orlicz functions, Fasciculi Mathematici **39**, 113-124.

14. B.C. Tripathy and M. Sen (2008): Vector valued paranormed ℓ^p spaces associated with multiplier sequences, Fasciculi Mathematici **39**, 125-133.

15. B. C. Tripathy and B. Hazarika (2008):I-convergent sequence spaces associated with multiplier sequence spaces, Math. Ineq. Appl. **11**(35), 43-548.

16. B.C. Tripathy and S. Borgohain (2008): The sequence space $m\ (M,\phi,\ \Delta^n_m,\ p)^F$, Mathematical Modelling and Analysis **13**(4), 577-586.

17. B.C. Tripathy, Y. Altin and M. Et (2008): Generalized difference sequences spaces on seminormed spaces defined by Orlicz functions, Mathematica Slovaca **58**(3), 315-324.

18. B.C. Tripathy; B. Choudhary and B. Sarma (2008): On some new type generalized difference sequence spaces, Kyungpook Mathematical Journal **48**(4), 613-622.

19. B.C. Tripathy and B. Sarma (2008): Sequence spaces of fuzzy real numbers defined by Orlicz functions, Mathematica Slovaca **58**(5) , 621-628.

20. A. Esi and B.C. Tripathy (2008): On some generalized new type difference sequence spaces defined by a modulus function in a seminormed space, Fasciculi Mathematici **40**, 15-24.

21. B.C. Tripathy, N. Subramanian and C. Murugan (2008): The double sequence space of Γ^2 Fasciculi Mathematici **40**, 91-103.

22. B.C. Tripathy and P. C. Das (2008): Some difference sequences of fuzzy real numbers, Fasciculi Mathematici **40**, 105-117.

23. B.C. Tripathy and B. Sarma (2008): Generalized Kothe-Toeplitz duals of some double sequence spaces, Fasciculi Mathematici **40**, 119-125.

24. N. Subramanian, B.C. Tripathy and C. Murugan (2008): The Cesaro space of double entire sequences, International Mathematics Forum **4**(2), 49-59.

D.3.2. Conference

1. G. Choudhury (2008) A retrial queueing model with a second optional service and with Bernoulli vacation schedule, Applied Mathematical Modelling (Ed. E.N.Virtanen), Nova Science Publishers, USA, 221-245.

2. K. Deka and G. Choudhury(2008) An M/G/1 Retrial queueing system with two phases of service and random breakdown , Proceedings of the 53rd Annual Technical Session of Assam Science Society (ED. Dilip Kumar Sarma), 262 – 272.

D.4. Conference/Workshop attended

1. Dr. (Mrs) L.B.Mahanta attended the workshop on "Introduction to Matlab and Labview" organized by Department of Physics, Gauhati University during December 19-20, 2008.

2. Dr. (Mrs) L.B.Mahanta attended the 7th North East Workshop on "Computational Intelligence Processing" organized by Electronics and Communication Sciences Unit, ISI held at ISI, Kolkata campus during September 23-25, 2008.

3. Dr. (Mrs) L.B.Mahanta attended the Symposium cum training programme on "Developing capacity building of young scientist for carrying out basic, clinical and operational research in the field of Nutrition" organized by Indian Council of Medical Research, New Delhi held at National Institute for Leprosy and other Mycrobacterial Diseases, Agra (U.

4. Mr. Chandan Nath attended the 8TH North East Workshop on "Computational Information Processing" organized by Electronics and Communication Sciences Unit, ISI and Department of Computer Science and Engineering, Tripura University held at Tripura University during March 23-27, 2009.

5. Ms. Stuti Borgohain attended the National Conference on "Advances in Mathematics" organized by the Gauhati University, held during September 4-7, 2008 and presented the paper titled "Sequence Spaces of Fuzzy Real Numbers Using Fuzzy Metric" written jointly with Dr.B.C. Tripathy.

6. Mr. Chandan Nath attended the workshop on "Introduction to Matlab and Labview" organized by Department of Physics, Gauhati University during December 19-20, 2008.

D.5. Research Collaboration

Dr. Binod Chandra Tripathy has collaboration with:

1. Professor B. Choudhary, Department of Mathematics; University of Botswana, Botswana.
Area of Research: Orlicz Type Sequences.

2. Professor Mikail Et, Department of Mathematics; Firat University; Turkey.
Area of Research: Sequences of Fuzzy Numbers.

3. Professor Yavuz Altin, Department of Mathematics; Firat University; Turkey
Area of Research: Sequences of Fuzzy Numbers.

4. Professor Ayhan Esi; Department of Mathematics; Adiyaman University; 02040 Adiyaman; Turkey
Area of Research: Difference Sequence Spaces

5. Professor Ahmet Sahiner; Department of Mathematics; Suleyman Demirel University; Cunur Campus, 32260, Isparta, Turkey.
Area of Research: Triple Sequence spaces.

6. Dr. N. Subramanian; Department of Mathematics; Sastra University; Tanjore - 613 402; India.
Area of Research: Double Sequence Spaces Defined by Orlicz Functions.

7. Dr. C. Murugesan; Department of Mathematics; Satyabhama University; Chennai- 613 402; India.
Area of Research: Double Sequence Spaces Defined by Orlicz Functions.

Dr. Gautam Choudhury has collaboration with:

1. Prof. Jau-Chuan Ke, Department of Applied Statistics, National Taichung Institute of Technology, No.129, Section 3, Sanmin Road, Taichung 404, Taiwan, Republic of China.
Area of Research: Control of queues

2. Prof. L.Tadj, Department of Management and e-Business, School of Business Administration, American University in Dubai, Dubai, United Arab Emirates.
Area of Research: Vacation Models, Retrial Models.

Dr. (Mrs) Lipi B. Mahanta has collaboration with:

1. Prof. Dilip C. Nath, Dept. of Statistics, Gauhati University, Guwahati – 781 014, India.
Area of Research: Distribution Theory.

2. Dr. D. Dutta Majumder Professor Emeritus, Indian Statistical Institute, Kolkata Director and Secretary, Institute of Cybernetics Systems and Information Technology (ICSIT) Kolkata – 700018, West Bengal, India.

Area of Research: Image Processing Pattern Recognition Learning Models

3. Dr. A.C. Kataky, Director, B. Barooah Cancer Research Institute, Guwahati, India.
Area of Research: Image Processing Pattern Recognition

D.6. Ph.D. Produced

(i) Mr. Amar Jyoti Dutta was awarded Ph.D. degree for his thesis "Studies on Fuzzy Real-Valued Double Sequence Spaces" under the supervision of Dr. B.C. Tripathy in 2008 by the Gauhati University.

(ii) Mr. Bipan Hazarika was awarded Ph.D. degree for his thesis "Studies on I-convergent Sequence Spaces" under the supervision of Dr. B.C. Tripathy by the Gauhati University in the year 2008.

(iii) Mr. Paritosh Chandra Das was awarded Ph.D. degree for his thesis "Studies on Some Fuzzy Real-valued Sequence Spaces and Density of Subsets of Natural Numbers" under the supervision of Dr. B.C. Tripathy by the Gauhati University in the year 2008.

D.7. Lecture delivered on invitation

Dr. G.Choudhury delivered an invited talk entitled "Single server batch arrival queueing system with service interruptions and Bernoulli vacations", in International Symposium on Probability and Stochastic Processes in honour of Professor S.R.S. Varadhan, FRS., held at Cochin University of Science and Technology, during Feb.- 6 to Feb.-8, 2009.

D.8. Other Activity

1. Dr. B.C. Tripathy is an Editorial Board member of the periodical "Journal of Advanced Research in Pure Mathematics" USA.

2. Dr. B.C. Tripathy is an Editorial Board member of the periodical "Journal of Advanced Research in Fuzzy and Uncertain Systems" USA.

3. Dr. B.C. Tripathy is a Reviewer of "Zentralblatt Math", GERMANY.

4. Dr. B.C. Tripathy is an Editorial Advisory Board Member of the journal "International Journal of Science and Technology", TURKEY.

5. Dr. B.C. Tripathy is an Editorial Board member of the periodical "Far East Journal of Mathematical Sciences"(Pushpa Publishing House), ALLAHABAD.

6. Dr. B.C. Tripathy is an Editorial Board member of the periodical "Journal of Indian Academy of Mathematics" INDORE.

7. Dr. B.C. Tripathy is an Editorial Board member of the periodical "Global Journal of Applied Mathematics and Mathematical Sciences", NEW DELHI.

8. Dr. B.C. Tripathy is an Editorial Board member of the periodical "International Journal of Mathematical Sciences", NEW DELHI.

9. Dr. B.C. Tripathy is an Editorial Board member of the periodical "Far East Journal of Mathematics" NEW DELHI.

10. Dr. B.C. Tripathy is an Editorial Board member of the periodical "Advances in Mathematical Sciences Journal", ALLAHABAD.

11. Dr. B.C. Tripathy has reviewed a book for Bentham Science Publishers, USA.

12. Dr. B.C. Tripathy was appointed as a book reviewer for the publisher McGraw-Hills India Limited.

13. Dr. B.C. Tripathy chaired 4 (four) paper presentation sessions in the National Conference on "Advances in Mathematics" organized by the Gauhati University, held during September 4-7, 2008.

14. Dr. G. Choudhury is the Editorial Board member of "Far East Journal of Theoretical Statistics "(Pushpa Publishing House), ALLAHABAD.

15. Dr. G. Choudhury is appointed as a Reviewer for "Mathematical Reviews", a review journal of American Mathematical Society, U.S.A.

16. Dr. G. Choudhury is appointed as a Guest Editor of the international journal "Quality Technology and Quantitative Management" for the Special issue "Management Policies of Queueing Control" FCU Press, Taiwan, Republic of China.

D. 9. Divisional manpower

Dr. Binod Chandra Tripathy, Ph.D.	
Associate Professor and Head In-Charge	
Dr. Jyoti Prasad Medhi, D.Sc.	Honorary Professor
Dr. Ganesh Chandra Das, Ph.D.	Honorary Professor
Dr. Gautam Choudhury, Ph.D.	Assistant Professor
Dr. Lipi B. Mahanta, Ph.D.	Assistant Professor
Mr. Amar Jyoti Dutta, Ph.D.	SRF Extended
Mr. Kandarpa Deka,	JRF
Mr. Stuti Borgohain,	Research Scholar
Mr. Hemen Dutta,	Research Scholar
Mr. Achyutananda Baruah,	Research Scholar
Mr. Rupa Chakraborty,	JRF
Mr. Chandan Kumar Nath,	JRF

Library and Information Center

The IASST Library and Information Center strives to evolve as a model and leading multidisciplinary science library in the field of Plasma physics, Polymer science, Mathematics & Statistics, Chemistry, biology (Medicinal plants, Sericulture, Bio-prospecting, Bio-fertilizers, Virology, Genetics, physiology, Fishery etc.), Agriculture, Biotechnology, environmental science, Nano science & technology and Computer Science.

Part View of Library

The Library and Information Center provides need based documents and information services to the scientists, research scholars, students and staff members of IASST, as well as outside users also. To share resources, a close liaison is maintained with some institutes in the country.

Visitors at Library

Library automation activity using the SOUL integrated library software package has been continued. Presently the Online Public Access Cataloguing (OPAC) and Circulation Services has been started. A Server, 4 PCs, 1 Scanner, 1 Printer, CD-Drives is the part of the set up of library computerization. The electronic databases at the library cover books only and for other documents the process is going on.

The library subscribed for 60 scientific journals both Indian & Foreign.and 7 newspapers. Out of 57 journals some are online accessibility. The library has full text access to several online journals through CSIR DST E-Journals Consortium.
Besides this, library received the annual report, newsletter, bulletin, and progress report from different organizations as a gratis/exchange document.

Library Collections

Books	7284
Journals (Bound Volumes)	1008
Journals subscribed for 2009	60
Journals received (Gratis/Exchange)	15
Reports	1648
Reprints	05
Thesis/Dissertations	257
Current contents of Journals	12
Misc. CD's	555

Other Facilities

Visitors using the Library	178
Circulation of Books/Journals etc	197
Photocopying (No. of pages)	49167
Number of Annual Reports mailed	110
No. of INTERNET Searches provided	05
Current Awareness Service	47
Selective Dissemination Information Service	29
Referral Service	68

Activities of Library personels

1. Workshop/Conference/ Seminars attended

1. T.D.Goswami, Asst. Librarian attended National Seminar on "Digitization and Networking of Library and Information Centers in North East India", jointly organized by Central Reference Library, Kolkata, Ministry of Culture, Govt. of India and Dept. of Library & Information Science, GU held in Guwahati University, Assam from January 9-10th 2009.

2. T.D.Goswami, Asst. Librarian attended the 6th Convention, PLANNER-2008 on "Open Access, Open Source Software and Open Learning", jointly organized by INFLIBNET Centre, Ahmedabad and

Nagaland University, Dimapur during 6-7th November 2008.

3. T.D.Goswami, Asst. Librarian attended National Workshop on "Trends in Library and Information Science Research", jointly organized by NSSDOC, ICSSR, New Delhi and Dept. of Library & Information Science, GU held in Guwahati University, Assam from May 7-9th 2008.

2. Papers Presented in Conference

1. "Training of library and information professionals for ICT application in libraries: an overview", T D Goswami, Asst. Librarian, paper presented in the national seminar on digitization and networking of library and information centers in north east India, held at Gauhati University during January 9-10th 2009.

2. "Open access: types of journals published", T D Goswami, Asst. Librarian, paper presented in the 6th Convention PLANNER-2008 at Dimapur, Nagaland University during November 6-7th 2008

3. Paper Published in Proceedings

1. T D Goswami, "Preservation and management of digital information resources in the modern library environment: some aspects". In the proceedings of national seminar on preservation and conservation of information resources in knowledge society: issues challenges and trends, March 3-4th 2009, Manipur University, Manipur.

2. T D Goswami, "Training of library and information professionals for ICT application in libraries: an overview". In the proceedings of national seminar on digitization and networking of library and information centers in north east India, January 9-10th 2009, Gauhati University, Guwahati.

3. T D Goswami, "Digital libraries: benefits, future and the role of the libraries". In the proceedings of 11th biennial conference of ACLA, November 27-29th 2008, M N C Balika Mahavidyalaya, Nalbari.

4. T D Goswami, "Open access: types of journals published". In proceedings of 6th Convention PLANNER-2008, 6-7th November 2008, Nagaland University, Dimapur, p. 181-187.

Colloquium Organized at IASST

Name of the speakers	Address	Title of the Talk	Date
Dr. Gautam Choudhury	Assistant Professor Mathematical Sciences Division , IASST	Development of Retrial Models	30/05/08
Dr. Arup Ratan Pal	Assistant Professor Material Sciences Division, IASST	Real time studies of surface toughness development and reticulation mechanism of advanced photoresist materials during plasma processing	27/06/08
Dr. Jibon Kotoky	Associate Professor Life Sciences Division, IASST	Under-standing the human skin, its diseases and an approach for its natural care	19/09/08
Dr. Devasish Chowdhury	Assistant Professor Material sciences Division, IASST	Contact Electrochemical Replication of frontal monolayer patterns.	14/11/08

General Administration

Manpower

Management

Director
Prof. (Ms) Joyanti Chutia , Ph.D., F.N.A. Sc.

Dr. Heremba Bailung, Ph.D	Registrar (i/c)
Rajesh Sharma, B.A	PRO
Juri Pathak, M.C.A	Ex.Secy to Director
Prabodh Ch. Deka, B.A	UDA
Rabin Kalita, B.Sc	LDA
Dwijen Deka, B.A	LDA
Prabhat Barma	LDA
Saraswati Bora	LDA
Diganta Das, B.A	LDA

Supporting Staff

Binoy Choudhury	Messenger
Madhu Ram Kalita	Electrical Helper
Ratul Baishya	Messenger
Srikanta Baishya	Field Attendant
Nripen Ch. Goswami	Messenger
Nimai Hazam	Driver
Phatik Baishya	Driver
Babul Deka	Messenger
Bipul Kumar Das	Messenger
Madhabi Das	Cleaner
Haren Medhi	Night Chowkidar
Lakhi Saud	Night Chowkidar
Satish Das	Day Chowkidar
Balabhadra Pathak	Watcher
Umesh Ch Deka	Messenger
Muktaram Kumar	Hostel Caretaker (Temp.)
Pradip Das	Mali
Munna Basfor	Sweeper

Library and Information Centre

Tarini Dev Goswami, M.L.I.Sc.	Asstt. Librarian
Niranjan Bhagobaty M.Sc(IT) PGDCA	Sr. Instructor
Kumud Baishya	Library Asstt.
Sarala Deka	Library Attendant

Accouts Section

Ganesh Ch. Bhuyan, M.Com	Finance & Accounts Officer
Suresh Sarma, B.Com	Accountant
Ramen Mahanta, B.Com	Jr. Accountant
Gora Gupta	Assistant

Engineering Cell

H.K.Saikia, B.E.	Civil Consultant
Montu Deka, B.E.	Junior Engineer
Munindra Singh	Console Operator

Management and Account Section

Receipt and Payment Accounts of IASST for the year 2008-2009. (Consolidated)

Receipt	Amount in Rs.	Payment	Amount in Rs.
Opening balance		Salary	1,59,27,621.00
Cash at Bank	1,16,703.87		
Cash in hand	10,072.00	Accommodation	5,89,060.00
Fixed deposit	22,79,608.00		
		Honorarium	1,77,705.00
Grand-in-aid from different project	3,32,29,611.00	Travel	12,01,748.00
Misc. receipt & Bank Int, Quarter rent, Electricity & Hostel rent etc.	1,97,402.09 1,05,851.00	Contingency	14,48,820.00
		Consumable	11,98,028.00
Earnest money	6,500.00	Overhead	9,69,238.00
Security deposit	2,000.00	Machinery & Equipments	29,15,887.00
Outstanding liabilities	19,99,883.00	Books & Journals	3,31,462.00
		Building & other component	12,52,623.00
		Unspent balance refund to DST, CSIR	6,27,135.00
		Outstanding liability payment during the year 2008-09	67,47,121.00
		Security deposit	30,600.00
		Bank charge	6,623.00
		Closing balance	
		Cash at Bank	21,64,279.96
		Cash in hand	10,072.00
		Fixed deposit	23,49,608.00
Total Rs.	3,79,47,630.96	Total Rs.	3,79,47,630.96

Personal Profile of Faculty Members

Name	e-mail Add.	Mobile No.
Prof. Joyanti Chutia, Director	joyanti_c@yahoo.com	09864032790
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Dr. Rajlakshmi Devi Asst. Prof.	devirajlakshmi@yahoo.com	09706033567
Dr. Arup Ratan Pal Asst Prof.	arup_trip@yahoo.com	09957174421
Dr. Devasish Choudhury Asst. Prof.	devasishc@gmail.com	09401454696

Obituary

Late Kabindra Deka,
(1962-2008)
Laboratory Attendant, Material Sciences Division

Kabindra Deka, laboratory attendant of Materials Sciences Division left for heavenly abode on July 26, 2008. Kabindra joined IASST on April 4, 1993 and had excellent service record during his tenure. He was simple, sincere in his duty and very obedient to his seniors and friendly to all his colleagues. His sincerity and inquisition led him to learn operating of most of vacuum systems and other technical equipment in the plasma laboratory. He had a chronic stomach problem which was diagnosed as stomach carcinoma in early 2008. His health was suddenly deteriorated and expired at the age of 48 years. Kavindra left behind his wife and two children. May his soul be rest in peace

Late Dr. Lalit Chandra Bora,
(1929-2008)
Ex –honorary Secretary of IASST

Late Dr. Lalit Chandra Bora,Ex –honorary Secretary of IASST and retired Associate Director of Extension Education, Assam Agricultural University, Khanapara, Guwahati, breathed his last on Sept. 8, 2008. Born in 1929 at Jaji village of Morigaon District of Asam, Late Dr. Bora passed his matriculation and IA examination from Cotton Collagiate High School and Cotton Collage, Guwahati respectively. He obtained B.V.Sc and M. V. Sc. Degree from Patna University and M.S. degree from Missouri University, USA.He served as Prof. of Animal husbandry, dairy is. at AAU, Jorhat

Apart from his professional life Dr. Bora was also known as a popular writer of Assamese literature. He wrote more than 500 articles and was published in various journals and newspaper of Assam. The books named RANG BERANG, BISARJAN, ABHINAYA and PIPEELIK Aare some of his most popular books. He also wrote some books on popular science namely HAH KUKURA PALAN ARU ROG NIBARAN, LAKHIMIR CHITHI and GAKHIRAR KATHA. He got prestigious literary pension from the Govt. of Assam.Dr. Bora will be always rememberd for his profound personality, honesty, simplicity etc. May his soul hest in peace.

Editorial Board

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