MINISTRY OF SCIENCE & TECHNOLOGY

ANNUAL REPORT
2009-2010

सत्यमेव जयते

विज्ञान और प्रौद्योगिकी विभाग

विज्ञान एवं प्रौद्योगिकी मंत्रालय

नई दिल्ली

Department of Science & Technology

Ministry of Science & Technology

New Delhi

Annual Report
2009-2010

Government of India
Department of Science & Technology
Ministry of Science & Technology
New Delhi

CONTENTS

OVERVIEW

The Department of Science and Technology, Government of India, has been able to initiate a large number of new and landmark programmes and measures of long term interest to the Science and Technology sector in the country during 2009-10. It has been a productive year for the Department. There have been conscious attempts to increase the efficiencies of internal processes and delivery of ongoing programmes, on the one hand and mount new initiatives with a potential impact on the Science and Technology landscape of the country, on the other. During the financial year 2009-10, some programmes which target transformational changes in the research and development have been initiated.

Some of the important landmark accomplishments of the Department and new initiatives made during the year 2009-10 have been summarized here.

1. Landmark Accomplishments and New Initiatives

A. New Mechanisms for Promotion of Basic Research

Establishment of Science and Engineering Research Board

Establishment of National Science and Engineering Research Board (SERB) as an autonomous body for promoting basic research has been notified in March 2010. Composition of the Board has been finalized. The Board is expected to play a major role in the promotion of Extra Mural Research in the country.

Implementation of Innovation in Science Pursuit for Inspired Research (INSPIRE)

Roll out of four of the five sub schemes of INSPIRE has been made during 2009-10. Total of 1,20,995 INSPIRE Awards for youth in the classes of V! to X from a total of 25 States and Union Territories have been released. Total of 55 summer and winter camps for about 14000 INSPIRE Interns for youth in the class XI have been organized. Seventeen Nobel prize winners have participated in these camps. 2396 INSPIRE scholarships for youth pursuing studies in basic sciences in mathematics, physics, chemistry and life sciences have been sanctioned while 360 INSPIRE Fellowships for doctoral studies for the top rankers in the university examinations have been sanctioned during 2009-10.

Special package for Infrastructure Strengthening of Academic Sector in Jammu and Kashmir

In order to promote basic research in the state of Jammu and Kashmir, a special package of Rs. 60 crores for the period 2009-2014 has been designed and delivered, Under this scheme, total of 38 colleges have been supported with Rs. 50 lakhs for strengthening laboratory infrastructure. 70 visiting professorships for senior faculty from other regions of the country to teach in universities in J&K region have been created. 70 visiting positions for young faculty of J&K for research in other region of India for duration of

3-6 months have been sanctioned. 100 fellowships for doctoral students from J&K for work in other regions of India have been provided. Special support for creation of back-up power facilities up to Rs.1.5 cores per university has been extended.

Consolidation of University Research, Innovation and Excellence (CURIE) for Women Universities

As a proactive measure for improving the research infrastructure in women only universities, a special scheme CURIE has been designed and delivered during 2009-10. Two of the six women universities received the support under the scheme during 2009-10.

B. Policy Formulation and Research

Science, Technology and Innovation Policy

A new Science, Technology and Innovation policy has been drafted for wider national consultation.Wide consultation among various stakeholders is planned during 2010-11.

Data Sharing and Access Policy

A policy framework for sharing and access to data has been drafted and inter-ministerial consultation completed during 2009-10. The policy would be formulated during 2010-11.

Academy for Science Policy Implementation and Research (ASPIRE)

A proposal for the establishment of an Academy for Science Policy Implementation and Research has been mooted.

C. Convergent Technology Solutions and Research Initiatives

Technology Mission for Winning, Augmentation and Renovation (WAR) for Water

Hon'ble Supreme Court of India directed Secretary, Department of Science and Technology to address water challenges and find out technical solutions to water problems through research on war footing. Technology Mission for Winning, Augmentation and Renovation (WAR) for water to be implemented during August 2009- August 2011 has been developed and launched. The budget outlay for the technology mission is Rs.145 crores. Under the mission 26 types of water related challenges have been identified and technology solutions for 10 types of challenges located in 25 clusters of human population of approximately 10,000 prioritized during the first phase of the project.

Solar Energy Research Initiative

A PAN IIT initiative for solar energy research has been mounted. Under the initiative, total of 37 faculties from 6 Indian Institutes of Technology have been networked for a coordinated project. A company has been commissioned to design, develop and establish 256 kw power plant in a village based on solar and biomass energy options within 18 months. Under the project, diesel power parity in terms of cost per unit being less than Rs 9 per kwh has been targeted.

Technology Compendium

A compendium of technologies developed and available with R&D institutions under various ministries of the Government of India has been prepared during 2009-10. Technologies from Department of Atomic Energy, Agriculture Education and Research, Biotechnology, Defence Research and Development Organization (available for civilian use), Earth Sciences, Science and Technology and Space are included in the compendium.

D. International S&T collaboration

Indo US Endowment Board

In order to support S&T cooperation with US, an endowment fund of USD 30 million has been created. In order to manage the fund, an Indo-US Endowment Board has been formed during 2009-10

EU-India Coordinated Call on Solar Energy

Based on a coordinated call for research on solar energy has been made inviting proposals from knowledge networks and consortia for competitive grants with a total budget outlay of 5 million Euors for a period of five years.

Indo UK Science Bridges

Indo UK science bridges in the research areas of Next Generation Telecommunication Networks, Solar Energy PV materials and two other areas have been mounted with UK funding UK partners and DST funding the Indian partners.

Formation of Indo German Science and Technology Centre

Approvals have been obtained for establishing an Indo-German Science and Technology Centre for promoting S&T cooperation in application areas of science and technology.

Establishment of Max Planck DST Institute on Computer Science

A joint virtual institute with Max Planck Society Germany on computational sciences has been launched in Indian Institute of Technology Delhi.

Indo Australia Strategic Research Fund

A joint fund of 100 million Australian dollars to be operated over a period of five years and deployed for funding projects under S&T cooperation between Australia and India has been established.

E. S&T Interventions for Social Good

Establishment of a new Mechanisms

In order to promote convergent technology solutions for applications in rural India, a new council for Science and Technology for Rural India (CSTRI) has been formed and two facilitation centres one at

North East Institute for Science and Technology and other at Indian Institute of Technology, Madras at Chennai have been established.

Conversion of National Innovation Foundation into an Autonomous Institute of Government of India

National Innovation Foundation has been supported through a corpus fund from DST for promoting grassroots and inclusive innovations for more than 10 years. Approvals have been obtained for conversion of NIF into an autonomous institution of DST during 2009-10.

F. Acquisition and Establishment of New Research Institutions

Institute for Advanced Studies in Science and Technology (IASST)

IASST, Guwahati has been taken over from the Government of Assam as an autonomous institution of DST during 2009-10.

Establishment of National Centre for Himalayan Glaciology: In order to institutionalize Indian research efforts on Himalayan Glaciology, a new national centre has been proposed. Nodal centre for the National centre has already been established as unit in the Wadia Institute for Himalayan Geology, Dehradoon.

G. Missions under National Action Plans for Climate Change

National Mission for Sustaining Himalayan Ecosystem (NMSHE)

Prime Minister's Council on Climate Change has accorded in principle approval for implementing a National Mission for Sustaining Himalayan Ecosystem. This national mission will be coordinated by DST in close collaboration with other sister departments especially Ministry of Earth Sciences and Ministry of Environment and Forests.

National Mission on Strategic knowledge for Climate Change (NMSKCC)

Prime Minister's council on Climate Change has accorded in principle approval for implementing a National Mission for Strategic Knowledge for Climate Change. This national mission will be coordinated by DST in close collaboration with other sister departments especially Ministry of Earth Sciences and Ministry of Environment and Forests with special oversight mechanism and mirror sites for data management and monitoring.

2. Output Indicators of Ongoing Programmes

Research and Development (Science and Engineering Research Council)

There have been significant increases in the number of Extra Mural Research projects funded under SERC during 2009-10 relative to those in 2006-07. Number of projects funded under SERC is 537 during 2009-10. This represents an increase of 68% over the number pf projects supported during 2006-07. In terms of funds sanctioned, this increase represents a growth of over 235% during the three years.

JC Bose Fellowships, Ramanujan Fellowships and Swarna Jayanthi Fellowships were awarded to 35, 27 and 5 scientists in 2009-10, respectively. A comprehensive Human Resource Development Programme in Mathematical Cciences has been approved by SERC.

During the year 2009-10, total of 355 new projects were sanctioned to young scientists under Fast Track mode. Total of 103 young scientists under the age of 35 received overseas fellowships for advanced training and 320 students were selected for prestigious KVPY fellowships during 2009-10. The growth trends in the number of projects supported under SERC for the years 2005-06, 2006-07, 2007-08, 2008-09 and 2009-10 are 253, 331, 495, 520, and 537 with budget sanctioned being Rs. 46,2, 68.6, 131.9, 144.2 and 160.8 crores, respectively.

Technology Development Programmes

Technology Development programmes implemented by DST are generally based on technology leads sourced from various public funded institutions in the country and linking them to translation and filed implementation of the technologies. Technology leads selected for translation and implementation are micro hydel systems for decentralized power generation, water purification for drinking water and solid waste management. Total of 30 Technology leads were selected for translation and further development and technology proving in more than 50 locations in the country.

S&T for Socio-economic Development

Programmes relating Science and Technology to socio-economic development by the Department have been of many types. In some cases, these pertained to the development of Entrepreneurships, technology incubations, women entrepreneurship parks, projects leading to capacity building of rural youth and weaker sections of the community. National Resource Data Management Systems (NRDMS) provide location specific data on natural resources using geo-spatial and other data. Science and Society programmes have delivered through long term core support to 17 field groups, training programmes for women and youth covering about 250 groups, and total of 35 new projects sanctioned during 2009-10. Several capacity building programmes involving self-help groups have been organized. The total number of people benefiting directly from the various programmes initiated under Science and Society scheme of DST during the year 2009-10 is estimated at 3,000.

S&T Entrepreneurship Development

During the last three years special momentum for establishment of Technology Business Incubators has been gained. Five new incubators were established during 2009-10 and seed support was extended to three Science and Technology Entrepreneurship parks. A status report on STEPs and TBIs has been brought out for the first time. Innovation and Entrepreneurship Development Centres (IEDC) is a new scheme under which six IEDCs were established during 2009-10. Science and Technology Entrepreneurship Development STED projects were further consolidated under which 2500 units were promoted during the year. More than 8000 students were imparted training in Entrepreneurship development during the year.

International S&T Cooperation

Under the various ongoing S&T cooperation related activities, eighteen workshops and thematic meetings and about 520 exchange visits, 416 new joint projects with support to more than 500 ongoing projects and seven programmes were facilitated. Active programmes of cooperation with 25 countries and EU, SAARC were supported during 2009-10. New intergovernmental agreements were finalized with six countries. Total of 13 joint committee meetings were held during 2009-10. CV Raman Fellowships with Africa fund making a provision for 1216 person months of research work per year in India were finalized.

National Data Management Information System

R&D statistics relating to Indian S&T sector for two financial years namely 2006-07 and 2007-08 were collected and brought out. Updating of R&D statistics data to gain currency has been prioritized during 2009-10. Global Research Report prepared by Thomson Reuters has brought out the growth trends in scientific publications from India. CAGR of publication rate is assessed at about 12% per annum for the last three year period. This is to be compared to the global rate of about 4% for the corresponding period. Relative position of India with respect to filing patents in the USA has improved from 25th in 2000 to 19th in 2006 and 16th currently. The Department has mounted a new initiative Science, Technology and Innovation and Creation of knowledge (STICK) with a view to develop innovation indicators and benchmarking of national innovation system.

Science Communication

More than 25 interactive programmes on science and technology covering all regions of the country were implemented during 2009-10. Children Science congress, Teachers Science Congress, Science Communicators congress, Hands-on science are some maga programmes organized by the Department during 2009-10. Total number of people to whom National Council for Science and Technology Communication (NCSTC) wing of DST connected during 2009-10 exceeds 15 lakhs of people. Science Express, a mega classroom on wheels, remained the flagship of NCSTC and since its launch in 2007 it has received about 50 lakh people, mostly students, at 150 locations across the length & breadth of the country in 600 days of running.

Survey of India and National Atlas and Thematic Mapping Organization

Survey of India and National Thematic Mapping Organization (NATMO) have carried out more extensive survey and prepared map data and products with increased spatial resolution for Open series maps. Generation of digital topographic data on 1:25000 scale is under progress. Of the 19390 sheets, 12027 have already been surveyed and 7874 sheets published in hard copy form with 5400 sheets being available in digital format in soft copy forms. Tidal observatory network has been upgraded by installing 25 digital tidal gauges co-located with GPS receivers along the Indian coast line.

Autonomous Institutions Nurtured by DST

Department supports total of 15 research institutions, 5 professional bodies and three specialized knowledge institutions covering a wide range of research and science and technology areas. Average number of publications emanating from these institutions during the last three years has been about 1350 per year with an average impact factor per paper of 2.3. During the year 2009-10, more than ten scientists working in the institutions received high academic honours in the form election to prestigious science academies, Shanti Swarup Bhatnagar prizes. Specific accomplishments of the institutions are elaborated in this report.

Nano Mission and Mega Science

Under Nano mission, 33 new projects were initiated during 2009-10. Indian beam line in Synchrotron at KEK, Japan has been built and made available to Indian scientists on 250 days a year on a dedicated basis. Negotiations have been completed for availing access to Petra III in Desy in Germany. This arrangement would provide access to 13 beam lines in the advanced facility for supporting research on materials science. Similar negotiations have also been completed for gaining access to Elettra at Italy for facilitating access to support macro molecular crystallography.

Drug and Pharmaceutical Programme

Six new collaborative projects between public funded institutions and industry as well as 8 loans for R&D in the private sector enterprises have been supported under Drug and Pharmaceutical programme. Phase 3 clinical trials for an Indian drug for malaria have commenced under this programme. New products for *Kala Azar* and anti AIDS have been launched in the market during the year 2009-10.

Innovation Cluster

A public-private partnership with NASSCOM for supporting innovation clusters in select sectors has been developed. Incubation centres on innovation are being promoted through a partnership with Technology Development Board.

Water Technology Initiative

Under water technology initiative, twenty technology products have been identified for assessment for applications in rural schools in 20 States. The assessment process has included evaluation of technical, financial as well social viabilities.

Training Programmes of S&T Manpower

Total of 41 training programmes have been conducted during 2009-10.

3. Resource Inputs planning and Deployment

Financial Deliveries

The total financial delivery of the Department has been 99.77% of the Revised Estimates of Plan funds. On account of implementation of several austerity measures, a net saving of Non-plan expenditures

has been realised. System for expenditure planning and monitoring has been standardized and implemented resulting in process efficiency

Structured Mechanisms for Determining Grant-in Aid to Aided Institutions of DST

After several rounds of brainstorming discussions and planning, a systematic approach to determine the level of Grant in Aid for Aided Institutions has been developed. Fixed costs of the institutions "A" were determined based on the number of scientific faculties contributing directly to the R&D outputs of the organization. Fixed costs per faculty have been set at Rs.30 lakhs per scientist. Development costs of the laboratories "B" covering R&D heads of equipment, consumables and chemicals as well as library have been computed at 66% of fixed costs of each institution. Objective methods for measuring the performance growth rate "C" over four of five selected parameters have been worked out. Consensus among all the Aided Institutions for determining the size of the annual Grant in Aid has emerged. The phase-wise implementation of the approach commenced during the financial year 2009-10. Evidence-based resource deployment strategy for R&D institutions nurtured by DST is being experimented.

CHAPTER 1

SCIENTIFIC RESEARCH, INFRASTRUCTURE AND HUMAN RESOURCES DEVELOPMENT

SCIENCE AND ENGINEERING RESEARCH COUNCIL

The Science and Engineering Research Council (SERC) of the Department has emerged as the single largest support system engaged in promoting basic research in all areas of science and engineering and has achieved significant success in furthering the growth of research in frontier areas. It has been the mainstay of open-ended basic research in the academic sector; about 44% of the extramural research funding in Universities/ Colleges was from SERC and the rest from 18 other Departments/ funding agencies.

SERC continued its programmes to promote research and development (R&D) in new and interdisciplinary areas of Science & Engineering. Projects to be sponsored under SERC are carefully selected through the concept of Programme Advisory Committees (PAC). It played a pro-active role in identifying challenging areas of research and supported proposals with defined objectives in these areas. SERC has over the years created a chain of research centers of excellence in diverse fields of S&T and contributed to augment R&D capabilities at academic institutions and national laboratories. Many of these Centres have advanced research facilities to attract young researchers.

Manpower Development is an integral part of the SERC Scheme. Innovative human resource development programmes were initiated/ continued. It continued supporting programmes like the *Kishore Vaigyanik Prothsahan Yojana* (KVPY), DST-JNC Summer Student Fellowships, Integrated Science Olympiad Programme, etc besides attracting Young Scientists to take up challenging R&D activities as a career.

The Council met thrice during the period and has approved projects in various broad areas of Science & Engineering. It has supported several training programmes, workshops and SERC schools in the areas of Solid State & Materials Chemistry; Advanced Biological Inorganic Chemistry; Green Chemistry applications, research activities & recent trends; Theoretical High Energy Physics; Nonlinear Dynamics; Nuclear Astrophysics & Neutrino Astrophysics; Astronomy and Astrophysics; Chronobiology- Clocks Rhythms & Behaviour; Herpetology; Neurosciences; Coastal Hydrology; Atmospheric Effects & Local Area Augmentation Systems; Aviation weather hazards; Matrix valuable calculus & statistical distribution theory and applications in data analysis, model building & astrophysics problems; Optimization theory and application.

The Council approved a comprehensive *Human Resource Development Programme in Mathematical Sciences*. It includes creation of regional forums for college teachers; development of non-traditional modes of delivery of education, primarily web based interactive methods; the International Congress of Mathematicians 2010 in Hyderabad and number of satellite conferences; Mathematics Initiatives for Women Students etc.

The contribution of Indian scientists in scientific Journals at national and global level is being recognised by the peers and S&T Academies. Some of them have received National & International recognition. Special efforts were made to identify active scientists, particularly Young ones, and Institutions in remote areas and encouraged them by providing research support, and Visiting fellowships, etc.

The Website for the SERC (www.serc-dst.org), which was launched eight years back, has been updated and is being used extensively by the scientific community.

Special emphasis has been given to the monitoring and evaluation mechanism of research programmes so as to asses the quality of work and research output. Several Group Monitoring Workshops have been organized in various disciplines in this period.

The Department, under the SERC R&D programme, sanctioned 527 Science and Engineering projects at a total cost of Rs.16030.4 lakhs. The discipline-wise and institution-wise break-up of funds is given in Fig. I & II.

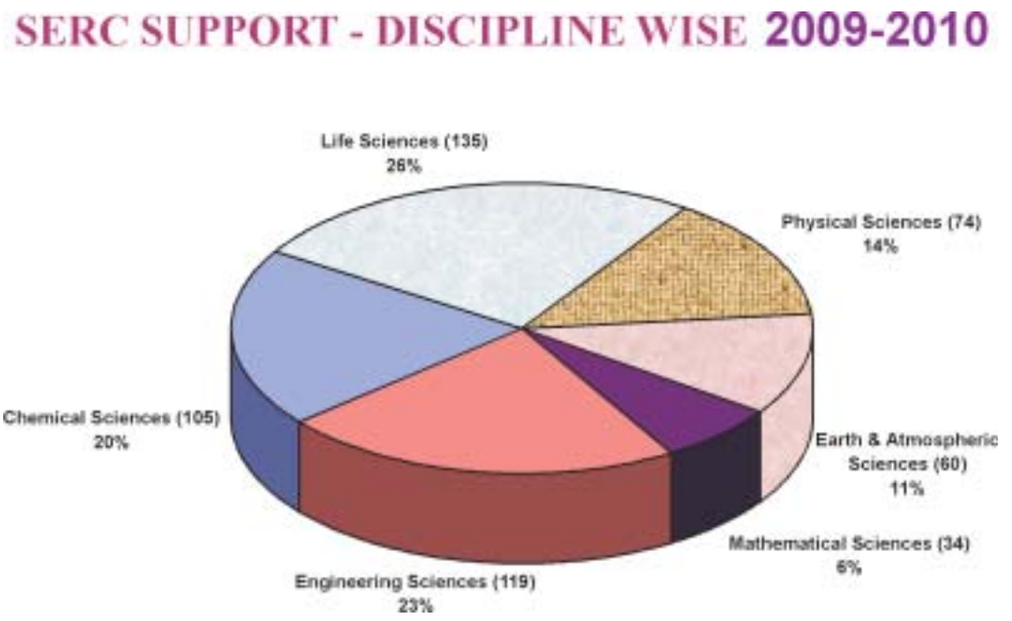


Figure I SERC Support – Discipline Wise 2009-2010

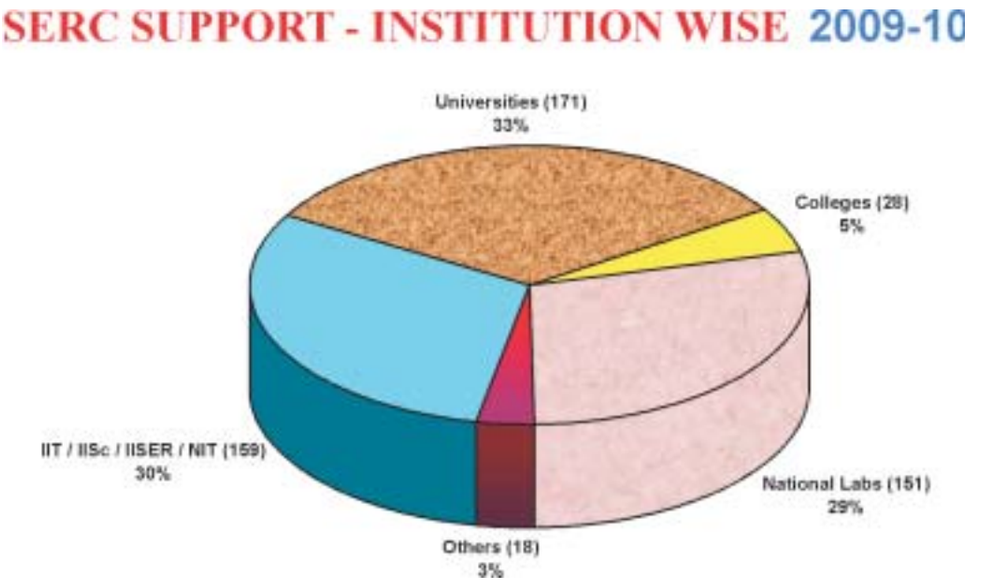


Figure II SERC Support – Institution Wise 2009-2010

R&D Projects sanctioned during 2009-2010

Broad Area	No of Projects	Sanctioned Cost (Rs in Lakhs)
Chemical Sciences	105	3261.1
Life Sciences	135	5308.8
Physical Sciences	74	2578.9
Earth & Atmospheric Sciences	60	1472.1
Mathematical Sciences	34	289.3
Engineering Sciences	119	3120.2
Total	**527**	**16030.4**

The JC Bose National Fellowships

To recognize active scientists and engineers for their outstanding performance and contributions, DST instituted JC Bose fellowships. These fellowships are scientist–specific and very selective and are open to Indian Nationals residing in India who are below the age of 60 years and are having regular positions in various institutions. The fellowship is granted for a period of five years. The value of the fellowship is Rs. 20,000 per month in addition to the Fellow's regular income. In addition, it carries a research grant of Rs.5.00 lakh per annum. 35 scientists were awarded this fellowship this financial year.

The Ramanujan Fellowships

The Department instituted Ramanujan Fellowships for brilliant scientists and engineers from all over the world to take up scientific research positions in India. It is especially directed at those scientists who want to return to India from abroad. The Ramanujan Fellows can work in any of the scientific institutions and universities in the country and they are eligible for receiving regular research grants through the extramural funding schemes of various S&T agencies of the Government of India. This fellowship is open to scientists and engineers below the age of 60 years. The duration of Ramanujan Fellowship is also five years. The value of the fellowship is Rs.75,000 per month for the first 3 years and Rs.60,000 per month during the last two years. Each Fellow, in addition, receives a research grant of Rs.5.00 lakh per annum. 27 scientists were selected for the award of this prestigious fellowship this year.

Swarna Jayanti Fellowship Scheme

The scheme was launched by the Government in 1997-98 to commemorate the 50th year if India's independence. Under the scheme, fellowship is provided to few outstanding young scientists upto 40 years as recognition of the research work done by them in Science & Engineering. A fellowship of Rs.25,000/- p.m. is provided under the scheme apart from the salary drawn by the fellow from his institute. A project that has novelty and innovativeness embedded in it is also supported along with the fellowship. The Department has awarded 80 such fellowship since 1997-98 and many of the fellows that were selected were subsequently selected as Shanti Swarup Bhatnagar Prize or as INSA or Academic Fellows.

During the year, 202 applications in various areas were received as against 127 last year. The selection process has 3 levels of scrutiny. During the last two years, the following candidates have been awarded the Swarna Jayanti Fellowship:

Swarna Jayanti Fellowship Awards – Year 2008

SL. No.	PI NAME & Address	Subject Area
1	Dr. Jitendra K. Bera, D/o Chemistry, IIT, Kanpur – 208 016.	Chemical Sciences
2	Dr. C. Balaji, D/o Mechanical Engineering IIT, Chennai – 600 036.	Earth & Atmospheric Sciences
3	Dr. G.V. Shivashankar, NCBS, Bangalore – 560 065.	Life Sciences
4	Dr. Pushkar Sharma, NII, New Delhi – 110 067.	Life Sciences
5	Dr. Arindam Ghosh, D/o Physics, IISc Bangalore – 560 012.	Physical Sciences

Swarna Jayanti Fellowship Awards Year 2009

Sl. No.	PI Name and Address	Subject Area
1.	Dr Pradyut Ghosh, D/o Inorganic Chemistry IACS, Kolkata – 700 032.	Chemical Sciences
2.	Dr Shanthi Pavan, D/o Electrical Engineering, IIT, Chennai– 600 036.	Engineering Sciences
3.	Dr Souvik Maiti, Scientist, IGIB, Delhi – 110 007.	Life Sciences
4.	Dr Debashish Goswami, Stat-Math Unit, Indian Statistical Institute, Kolkata – 700108.	Mathematical Sciences
5.	Dr Abhishek Dhar, Theoretical Physics Group, Raman Research Institute,Bangalore – 560 080.	Physical Sciences

Dr. Abhishek Dhar who was slected for this fellowship this year was also awarded the Shanti Swarup Bhatnaar Prize for the year 2009.

The discipline wise details of the achievements are as follows:

CHEMICAL SCIENCES

Support to frontier areas of research continued. Several projects have been funded a few being in the interface area of Organic Chemistry-Biology-Pharma. Several training programs have also been organized.

Organic Chemistry

The following are some of the new projects funded during the year.

- Acyl transfer reactions in the solid state: Quantitative structure- reactivity correlation, mechanism and investigations towards creating supramolecular structures that exhibit acyl transfer reactivity
- Towards the expansion of the genetic alphabet: Design, synthesis and study of physical/photophysical properties of unnatural nucleoside base analogues and incorporation into short oligononucleotide sequences
- Biomimetic studies of porphyrinogens and their non covalent interactions in the biosynthesis of heme and related life pigments

- Design of organic-inorganic hybrid materials and exploration of their gas adsorption and disorption properties
- Development of novel cyclophanes as probes for biomolecular recognition
- Tuning the properties of stimuli sensitive copolymers- A step towards purification of water
- Synthesis and evaluation of S-Triazine based novel polymeric light stabilizers for polyurethane photostabilization
- Organocatalytic approach for the total synthesis of Sanglifehrin-A, Papulacandins, Fumonisin-B and Tamiflu
- Chemical & Biological evaluation of selected Indian medicinal plants for anti-cancer activities
- Development of chiral catalysts for asymmetric hydroformylation of olefins for the synthesis of chiral drug intermediates
- Investigation of gamma and hybrid gamma helical peptides as HIV-1 fusuin inhibitors
- New methods for the synthesis of medium-ring azacycles based on vinylogous carbamates
- Synthesis and pharmacological evaluation of biologically potent heterocyclic systems
- Development of perylenebisimide based n type semiconducting materials for opto-electronic applications

A new initative in the interface areas of Organic Chemistry- Biology-Pharma was launched, and two proposals were supported. One was to develop glycobiology oriented nanotools for development of NEU-3 (human sialidase) inhibitors and explore their use for imaging of cancer cells. The second is to adopt chemical genetics approach to dissect pattern formation in the cellular slime mold *Polyspondylium*

Some significant achievements are given below:

- An efficient route for synthesis of new di- and tri- mesogenic compounds containing cholesteryl moiety by Cu(I)-catalyzed azide-alkyne cycloaddition 'Click' chemistry has been developed. This is the first report of cholesterol based liquid crystal using 'click' chemistry. The dimesogenic compounds shows SmA* '!SmC* transition due to acentral transverse dipole derived from DFT study and the branched chain of rigid cholesterol part plays an important role for stabilizing the SmC* phase.
- Many one-pot, multi-component, atom economical and sequential reaction methodologies for synthesizing novel multi-functional molecules in high yield and selectivity were developed. 1,3-Dipolar cycloaddition of the anion of diethyl 1-diazomethylphosphonate, generated *in situ* from diethyl 1-diazo-2-oxoprophylphosphonate (Bestmann-Ohira reagent), with conjugated nitroalkenes gave regioisomerically pure phosphonylpyraxoles in moderate to good yield. These pyrazoles are formed in one pot via spontaneous elimination of nitro group.
- Discovery of 1-formyl-9H-^{2}-carboline as new electrophile for the Baylis-Hillman reaction and the utility of its product for the synthesis of canthinones and canthines was demonstrated.
- A simple and efficient methodology has been developed for the one-pot preparation of ±-methylene-^{3}-butyrolactones by free-redical induced Barbier-type reaction of methyl 2-(bromomethyl)acrylate and aldehydes followed by *in situ* lactonization.

❖ Synthesis of large generations (upto 6) of alcohol-functionalized poly(ether imine) (PETIM) dendrimers has been achieved. These dendrimers were tested as organometallic catalyst in C-C bond forming reactions such as Heck and Suzuki coupling reactions. From a series of studies, it emerged that the multivalent catalysts were superior than monovalent catalysts. This study has opened up a new, hitherto unknown possibility in catalysis, namely, significant increase in catalysis as a result of clustering the catalytic sites.

Inorganic Chemistry

Some of the new projects sanctioned are:

➢ Synthesis and Co-C bond reactivity in cobaloximes: Cycloadditions and molecular box assemblies with two and more cobalt systems

➢ Thermodynamics of the inverse melting phenomenon in binary alloys : Experimental studies and *ab initio* simulation

➢ Dioxygen activation and haloperoxidase activity by mononuclear non-heme iron (II) complexes

➢ Bimetal core-shell nanomaterials embedded in silicate sol-gel and polymer membrane modified electrodes and their applications

➢ Interaction of vanadate, molybdate and tungstate with hydrogen peroxide and hydroxylamine: Synthesis, characterization, reactivity, aqueous and solid state properties

➢ Models for the photosynthetic reaction center: Synthesis, structure, reactivity and photo-physical properties of porphyrin dimers and rationalization of supramolecular chirality

➢ Design and synthesis of fluorinated metal organic framework materials (F0MOFs) for reversible gas storage and sequesteration applications

➢ Preparation of complexes by anchoring peroxo species of V(V), Mo(VI) and W(VI) to polymer matrices and explore their biochemical properties particularly the effect on enzymes and catalytic properties in organic oxidations.

➢ Development of convenient synthetic routes to obtain chalcogen (mainly Se and Te) containing N-heterocyclic (viz. Pyridine, pyrimidine, quinoline) derivatives under mild conditions and study their use in organic synthesis. The solubility of the compounds will be enhanced by using micellar/ microemulsion media

➢ Investigation of solubility and catalytic properties of substituted hydroxyl, fluoro and oxy apatite ceramics

➢ Development of analytical methodology for the determination of trace metals using FIA- complexed to SPME and AAS. This involves synthesis of new chelating reagents and study their efficacy for FIA

➢ Preparation of polymer-anchored coordination complexes and study their binding propoerites to nucleic acid with a view to explore their uses for anti-tumor properties.

➢ Synthesis of new organometallic complexes of group 4 metals (Ti,Zr and Hf) that possess Schiff base and amine ligand scaffolds and testing them towards the polymerization of cyclic ester monomers

(ε caprolactom, valerolactone, â butyrolactone, glycolide and lactide) and ethylene. The intention is to use them as viable catalysts for polymerization reactions.

Some important results that have come out from ongoing projects are given below:

- Novel tetra organo ditelluroxanes (containing picrate groups) and bis(ferrocencyl carboxylato) telluranes have been synthesized and characterized. These compounds could be useful precursors for tellurite glasses which are likely to exhibit non-liner optical properties.
- Simple synthetic methodology has been developed to synthesize porphyrnogens and its related molecules like porphyrins and corroles. Most of these are fully characterized and their interactions with different ions and molecules (host-guest) were studied in detail. Metalation of these porphyinogens is achieved to show that in contrast to porphyrins direct incorporation of trivalent metal ion is possible in porphyrinogens.
- Several metal phosphate, phosphinate and phosphonate complexes bearing alkaline earth metal ions, transition metal ions and main group elements have been prepared. Many of the copper phosphate and phosphinate complexes synthesized during the course of this study were tested as catalysts in the oxidative polymerization reaction of 2,6-dimethylphenol. All the complexes tested were found to be excellent catalysts yielding high molecular weight polymer PPE with relatively good selectivity.
- A variety of organomercury compounds having both multiple Lewis acidic as well as Lewis basic sites were synthesized and their structural chemistry, bonding and anion recognition property has been explored.
- Organochalcogens with two ortho-coordinating groups gave access to a variety of novel compounds. Role of intramolecular interaction and additional substituent in the ortho position in stabilizing organoselenium compounds especially selenenyl bromides and their subsequent cyclization to ester were established.
- Intramolecular interactions were employed to isolate novel, stable ionic selenenyl chloride, bromide and tribromide. These compounds are excellent GPx mimic in bioassay.
- The first ambient temperature stable covalent selenenyl azide was synthesized and its reactivity has been studied.
- Novel palladium complexes of organochalcogens have been synthesized and structurally characterized. It gave access to a variety of palladium complesex with different nuclearity and novel Pd···Pd interaction.

A School on Advanced Biological Inorganic Chemistry was organized. Several tutorial lectures were given by distinguished scientists from India and abroad and laboratory experiments were demonstrated to the participants.

Physical Chemistry

Some new projects sanctioned are as follows;

- Couple cluster based linear theory (CCLRT) and closely related equation of motion based coupled cluster (EOMCC) methods to study the excited/ ionized state energies and electron properties of

heavy atoms. Codes applicable to large systems at a reasonable computational cost and perform large- cale computations are being developed.

- Investigation of similarities between diffusion across various condensed matter phases using MD and Monte Carlo techniques. This will help in fundamental understanding of diffusion of both monatomic and real molecular systems in diverse phases.
- Design and synthesis of pyrazoline polymers containing triazole receptor for sensing metal ions.
- Preparation of micro/ nano MgO from bittern solution and evaluate their surface characteristics as well as catalytic activity in some important organic reactions.
- Systematic QM/ MM study on a set of hydroxylase enzymes. The study is expected to help in fundamental understanding of enzymatic action in biological systems
- Atomistic molecular dynamic simulations of unfolding dynamics of globular proteins under different denaturing conditions and unfolded state.
- Study of electron transfer coupled proton transfer reactions of various meso substituted porphyrin derivatives using time resolved spectroscopic techniques.
- Study of liposome-DNA and liposome-protein complexes by electrochemical and piezoelectric weighing methods

Some significant results obtained form ongoing projects are given below:

- Analytical gradient based geometry optimization with improved virtual orbitals have been developed using intruder free multi-reference perturbative and non-perturbative formalism approach. The optimized geometry resulted from this study is as accurate as obtained from widely used complete active space self-consistent field (CASSCF) procedure and is also computationally less expensive. Further, "improved virtual orbital" based method is available in GAMESS, an open source quantum chemistry package.
- Ilmenite $AgSbO_3$ was synthesized by ion-exchange reaction of $NaSbO_3$ with silver nitrate and it was characterized using various techniques and studied for the photo-catalytic applications. $AgSbO_3$ exhibited unique optical absorption behaviour capable of absorbing UV and visible light with wavelength » d"500 nm. Investigation of photo-catalytic degradation of dyes such as methylene blue and rhodamine B agreed well with the optical absorption behaviour and showed excellent activity under UV light radiation. The investigation points towards the possibility of ilmenite form of silver antimony oxide as a potential visible light based photo-catalyst for splitting water to produce hydrogen.
- Solvation dynamics in microheterogeneous water channels of Nafion membranes have been performed using steady state and time resolved fluorescence techniques. It has been found that the water channels of Nafion are found to consist of at least two different regions: water molecules near sulphate groups exhibit typical slow & ultraslow dynamics observed in microheterogeneous media, whereas the aqueous core appears to exhibit bulk-water- like ultrafast relaxation. This is the first solvation study of such systems.
- Photofrangmentation spectroscopy of molecules relevant to atmospheric processes has been studied. The apparatus with a quadrupole mass spectrometer has been built and several interesting studies

have been performed. UV photodissociation of various carbonyl compounds have been studied and analysed both by mass spectrometry and FTIR spectroscopy. The fragmentation mechanism of 1,2 –cylcohexanedione (1,2 CHD) has been proposed.

Photograph of photofragmentation apparatus

Green Chemistry

The following projects were sanctioned during the year:

- Development of nanostructured membrane for solvent recovery from organic solution.
- Production of Lactic acid in membrane-integrated hybrid reactor system-A green technology approach. The process is based on renewable sugar cane juice feedstock and is energy efficient.
- Development of ecofriendly process for reuse of waste plastics for laying plastic tar road in cold regions
- Development of fly ash/ polymer composites as green building materials like floor tiles, pavement tiles, concrete repairing etc.
- Investigation on synthesis, development and applications of metal-proline complexes as organo-catalysts for organic reactions in aqueous media
- Development of an environmentally friendly, biodegradable plastic from bacteria which can be used as a packing material.

Workshops were organized to enhance the awareness among students, teachers and scientists as well as industry to adopt Green Chemistry principles & practices. A SERC School was organized to introduce diverse aspects of Green Chemistry to young faculty and researchers working in various institutions.

Some highlights of the results are as follows:

- A solid green reagent utilizing liquid bromine precursor (instead of toxic liquid bromine) was developed and used as brominating agent for many organic transformation reactions. The precursor comprises of either a 5:1 or 2:1 mole ratio of NaBr- $NaBrO_3$ which releases bromine on demand upon acidification. Processes have been developed for bench scale preparation of high purity and desired yields of bromoproducts. These have been protected by US and PCT Patents. Dialogue with industry is on for technology transfer.

- A study for degradation of polypropylene using biosurfactants was undertaken. Biosurfactants help in degradation of various hydrocarbons by helping the microbes to bind to the polymer surface and use it as a carbon source. Biosurfactant producing new strains of *Bacillus subtilis* YB7 and *Pseudomonas aeruginosa* from plastic dump site and petroleum contaminates sites were isolated. Production kinetics of surfactants, parameters affecting the production of glycolipid and biofilm formation and degradation of PP were studied.

- Biocomposites were prepared using Polypropylene (PP) as the matrix and the natural fibres, *Hildegardia populifolia*, as reinforcement. This natural fibre possesses better mechanical properties and is available in large quantities in Andhra Pradesh. The tensile properties were found to be higher when the compatibilizer was used.

- With a view to accurately determine the role of ionic liquids in different chemical processes, thermosolvatochromism has been studied in three series of ionic liquids. Viscosities of binary mixtures of pyridinium based ionic liquids (1-butyl pyridimium tetrafluoroborate [BP][BF_4], 1-butyl 3-methyl pyridinium tetrafluoroborate [3-MBP] [BF_4],1-butyl pyridinium 4-methyl tetrafluoroborate, [4-MBP] [BF_4] and phosphonium based ionic liquids, (tetra butyl phosphonium alaninate [TBP] [Ala], tetra butyl phosphonium valinate [TBP][Val]) with molecular solvents water, methanol, dichloromethane has been measured at 298.14 K. The fall in viscosity in the close vicinity of pure ionic liquid is more prominent in polar solvents like water. A drastic reduction in viscosity of ionic liquid upon addition of a solvent like water has been considered as a point on which the reactions can be planned for achieving higher rates. Diels-Alder reactions were carried out in such ionic liquid solutions with a sharp increase in yields.

PHYSICAL SCIENCES

The research projects and programmes supported under Physical Sciences covered a wide range of emerging topics. The technical evaluation was done by respective Programme Advisory Committees (PACs) which also monitored the progress made in ongoing projects.

Condensed Matter Physics and Materials Science

A broad spectrum of research activities were supported through the sanctioned projects.

In a project, optimization of the metallization process, etching process and passivation process for AlGaN/ InGaN/ GaN systems (nitride based III-IV compounds) is being done. UV-LEDs will also be

fabricated and characterized. LED in the 410nm region to be produced in the project. In another project, technology for epitexial growth of group-IV semiconductor hetero-structures for high-mobility MOSFETs and floating gate Ge nanocrystal memory devices will be developed. In a different project, ZnO nanostuctures is being synthesized through sol-gel technique and characterized by structural, electrical and optical properties. ZnO diodes are being fabricated to achieve the lasing action.

Different polymeric materials are being synthesized and characterized after irradiation with swift heavy ions and their correlation with the performance of organic-FETs established in a project. Development of the LED devices with improved efficiency through better utilization of triplet excitons, hole and electron blocking layers and improved contact materials to be undertaken in a different project. In another project, white light emitting OLEDs using conducting polymer PFO (for blue component) and phosphorescent dyes (for green and red) are being developed. Using the phosphorescent dyes, it was expected to utilize both singlet and triplet excitons enabling them to attain higher energy conservation efficiency.

Synthesis, characterization, evaluation of dielectric/ ferroelectric properties, structure- property correlations etc. of low lead and lead free ferroelectric-piezoelectric composite materials are undertaken in a project. In another project, different types of DLC materials are being synthesized. Measurement of their optical properties like birefrigerence, tilt angle, switching, dielectric anisotropy, etc along with spontaneous polarization of FE and AE LC phases in the DLCs formed by their chiral molecules being made. Organic-inorganic hybrid nanostructured liquid crystals materials are being prepared in another project. Rare earth doped KTP single crystals would be grown and characterized for electro-optic applications.

Theoretical investigations on Kondo effect and STM conductance spectrum in graphene is being performed in another venture. Studies on effect of disorder and the presence of external bath on nature of defect production when system is quenched across the quantum critical point are being carried out. In another project, calculations for optical properties of the bulk chalcopyrite semi-conducting compounds and the electronic and optical properties of the defect chalcopyrite compounds to be undertaken while dynamics of the self organized criticality (SOC) in a complex and evolving network is being studied by Monte Carlo simulation in anohter. Theoretical and numerical techniques to model plasmonic waveguide structures for sub-wavelength applications are under development in a while a theoretical study of correlation between plasma parameters with structural characteristics of carbon nanotubes has been undertaken in a different project.

In a project, fabrication of an ammonia gas sensor from conducting polymers, both in bulk and thin film forms is be attempted. CNT integrated epoxy polyacrylate blends to be synthesized in a separate venture. Study of the replacement of polar and non polar organic solvents used in the preparation of epoxy polyacrylate blends by supercritical carbon dioxide being undertaken in yet another task while physical properties and underlying physics of stoichiometric, off- stoichiometric and transition metal/ metals substituted alloys, with an intention to develop high power factor thermoelectric devices for power generation are studied in another. Yet another project attempts to study of FFLO state in a variety of systems, including specifically cold atom systems will be done. Relationship between fermionic superfluidity and atomic superfluidity is the topic of a study while separately giant magneto-impedance of Fe and Co based amorphous alloys are being investigated. Electrical resistivity on transition metal oxides and silicate minerals at high pressure–high temperature are being undertaken to understanding phase transitions and associated variations in the properties of the materials in a different project.

Studies towards the identification of the pigments present in ancient Indian paintings and other art work available at archaeological sites and in the different museums across the country with Raman microscopy have been initiated and in a different project, lead free ceramic dielectric resonators based on barium titanate zirconate, barium titanate cerrate and barium niobate zirconate would be developed through both solid state and mechanical milling techniques**.** A project has been awarded to study effect of f-electron on the mechanical structural electronic and optical properties of f-band materials under pressure while another one looks at Ion transport mechanism in different ion conducting systems (electrolyte and positive electrode material).

Several interesting results were reported from ongoing projects:

Nanomagnatic particles of manganites, Mn-Zn-ferrite and cadmium ferrite and Ho-subsituted ferrite were synthesized and characterized. Some particles were coated with Dextran, citrate and silica. XRD, FTIR, VSM and TGA were used to characterize the particles. Applicability of these systems for biomedical and biotechnological applications was studied in the project.

In another project junctions were formed between a monolayer of an organic donor molecules, a monolayer of a p-type nano-parlticle & a monolayer of an n-type nano-particle, and a monolayer of inorganic nano-particle & a monolayer of an organic molecule. All the junctions showed rectification. Mechanism of rectification was studied in detail and the results had been explained by means of suitable energy band diagram.

Magneto-optical imaging was performed at low temp. (10K), high magnetic field sensitivity (<10 m Gauss) with spatial resolution of 0.7 microns. Transport current imaging via the self field was successfully employed. Imaging of local magnetic field distribution inside superconductors, which are nanopatterned, was done.

Low field ZFC/FC magnetization and ac-susceptibility in a Fe/Cr multilayers, prepared by ion–beam sputtering showed spin glass like phase with logarithmic magnetic relaxation in another project. Electrical resistivity of the PLD grown self assembled, epitaxial nickel nanocrystallites in TiN matrix at lower temperatures showed conclusively T dependence below the observed minima at T_{min} unlike InT in 2D multilayers.

In another project, a variable temperature and high vaccum (HV) STM/STS system with up to 5T magnetic field had been successfully developed and tested. A HV chamber, for in situ annealing, cleaning or cleaving of the samples, was also installed. Nearly electronically homogenous four different composition epitaxial thin films of colossal magneto-resistive manganites were studied.

Plasma, High Energy, Nuclear Physics, Astronomy & Astrophysics and Nonlinear Dynamics

The supersymmetric extension of the Left-Right symmetric models to describe some of the aspects of Physics beyond the standard model for elementary particles is being explored. Detailed implications of the "proton spin problem" and the weak axial form-factor for the semi-leptonic decays of hyperons in the chiral constituent quark model with the latest data available from various experiments is under study in another project. In a different project, ·-nucleon and ·'-nucleon coupling using light-cone QCD sum rules, including $SU(3)_F$ breaking are under investigation.

Quasar absorption lines provide important information on the properties of material in their host galaxies, interstellar medium of the intervening galaxies and the intergalactic medium. One project aims to

determine the chemical abundances in a statistically large sample of Damped Lyman Alpha and sub-Damped Lyman Alpha systems at low redshifts to understand the chemical evolution of galaxies and the dust content of the absorbers In another project, a systematic and unified database of interstellar absorption in the Galaxy from various available astronomical data is being created with the ultimate goal of creating a 3-D map of the interstellar medium. One project deals with the nature of the "Dark Energy" that constitutes more than 70% of the energy content of the Universe. Another project deals with the observation of radio emission from extra plannar region of edge-on disk galaxies. X-ray variabilities of a selected set of active galactic nuclei (AGN) and their correlation with those in other wavebands is being studied in another project.

Theoretical and experimental study of quasi-free knockout and transfer reactions are investigated in another project. The band structure in nuclei in the framework of Deformed Hartree-Fock model with Angular Momentum Projection is also being explored.

In a project, design and fabrication of a microwave plasma assisted atomic layer deposition system, characterization of the plasma parameters and investigations on the effect of plasma parameters on the properties of nano layers of pseudo binary oxide high-k-dielectrics deposited by the same is being done. Synthesis of ultra-nano-crystalline diamond films for field emission applications using microwave plasma enhanced chemical vapour deposition to be synthesized in another project. Studies on plasma surface modification of polyester fiber and fabric is being carried out to enhance dye uptake properties with natural dyes. In a different project, development of Compositionally& Microstructurally Graded Thermal Barrier Coating by Plasma Spraying is under study. In a different project, physics of dusty plasmas and its applications in systems in real life is the focus.

SERC Preparatory School in Theoretical High Energy Physics was held at IIT, Chennai during 4-31 October 2009 while School on "Nonlinear Dynamics" was held at Delhi University during 8-28 December 2009. One SERC School in the Experimental High Energy Physics was held at IIT, Mumbai during 8-28 December 2009. SERC School on "Nuclear Astrophysics and Neutrino Astrophysics" was held at University of Calicut, Calicut from 18 January to 8 February 2010.

Several interesting results were reported from ongoing projects:

In a project, the nuclear reaction has been investigated with an emphasis on the meson and ^{7}Be interaction in the final state. Measurements of the differential and total cross sections for the reaction at five energies were reported and comparison with theoretical models were made.

The effect of inhomogeneities and absorption in the medium and initial curvature of the beam on self focusing has been investigated in a project. Mutual focusing of the beams in plasmas and magnetoplasmas and the condition for propagation of a number of beams in the uniform waveguide mode had been derived. The effect of thermal conduction on self focusing in plasmas and the ionosphere had been evaluated. The mutual attraction of two parallel beams in plasma and the ionosphere had been evaluated. Ring formation in electromagnetic beams in underdense and overdense plasmas have also been examined. The nonlinear propagation parameters and self focusing in the ionosphere too was investigated. The three regimes in the radius-power plot for self focusing in a magnetoplasma were characterized. Some problems on self focusing filamentation instability had been investigated. The growth of a ring ripple in a plasma and magnetoplasma was also investigated by incorporating a single dielectric function, determined by the resultant of the main beam and the ripple.

Lasers, Optics, Atomic and Molecular Physics

In a project, cooling of molecular ions with the technique of sympathetic cooling using Ba+ in an ion trap for the purpose of high resolution spectroscopy has been studied and a facility to develop a capability of performing molecular spectroscopy at a few 100 KHz is being setup. Another project explores linear and nonlinear optical effects in nanostructure materials with very high spatial and temporal resolution. Establishment of cavity ring down spectrometer for absorption measurements of trace species in the earth's atmosphere is being established in another project.

Conformational landscapes spectroscopy and dynamics of some bio-molecules and their hydrated clusters has been undertaken in a project while another one focuses on effects of confinement of atoms or ions in plasma on their spectra.

Development of digital holographic techniques and their applications for the study of vibrations, contouring of diffused objects and measurement of temperature in fluids (liquids and gaseous flame) is to be done in a project. A different project attempts to develop swept source optical coherence scanning microscope for 3 D-surface profilometry and tomography.

Growth and characterization of some organic NLO materials for various optoelectronic applications is being studied in a project and double tungstate single crystals are to be developed for Raman laser devices in yet another.

SERC School on "Atomic and Molecular Physics" was held at Physical Research Laboratory, Ahmedabad during March 2009.

Several interesting results reported from ongoing projects are as follows:

In a project, a non–mechanical scanning Optical Coherent Tomography (OCT) system had been developed for application in 3D-surface profilometry and tomography. A non- mechanical scanning Talbot self-image plane shifting system was also demonstrated. The high resolution and high contrast imaging of polystyrene spheres, onion films and blood cells were carried out using SS-OCT system. Synthesis of spatial coherence of the light generated by broad band Super luminescent diode (SLD) was carried out and investigation on the effect of the spatial coherence of the light on the visibility of the interference fringes was done.

In another project, several microstructure in PMMA/ PDMS were fabricated successfully. The nanostructures were obtained in Baccarat glass. The laser–matter interaction for various writing conditions in different materials were studied by Raman, UV–visible, FTIR, laser confocal, SEM and ESR spectroscopies. Fluorescence from laser written regions of fotran glass was demonstrated.

The white light emission was achieved in the rare earth doped telluride glass systems in another project. Sol-gel technique for glass preparation was developed. The terbium doped sol gel silica glass gave very good emission in green and blue region. Nano particles of silver, gold and bismuth metals were prepared in water, glycol, methanol, etc using the laser induced liquid ablation system. Some rare earth doped phosphors were prepared through combustion method. Intense up conversion emission had been observed in Er^{3+}/Yb^{3+} doped Gd_2O_3 phosphor.

Optically transparent crystals with sizes upto 7 cm in diameter were grown by slow evaporation and slow cooling methods in another project. The seed crystals with (001), (100) orientations were mounted in

the ampoule separately with various thickness to grow bigger size crystals. The mounted ADP and KDP seed crystals with various directions grew as large transparent crystals.

In another project, appropriate nonlinear evolution equations and studied soliton propagation and modulational instability in nonlinear birefringent fibers, wavelength division multiplexing systems, dispersion managed fibers, fiber Bragg grating structures, photonic crystal fibers, Bose-Einstein condensates, nonlinear bulk media, nano materials, and negative refractive index materials was devised.

LIFE SCIENCES

Animal Sciences

Capacity building activities

Various innovative capacity building exercises were organised during the year. These involved faculty members from different parts of the country and abroad. The participants were heterogeneous in nature, selected after thorough scrutiny. These programmes enabled renewal and exchange of ideas among the participants and faculties in the respective areas.

SERC Schools were organised in different areas such as a) SERC School in chronobiology held from 25 December 2009 to 7 January 2010 at JNCASR, Bangalore; b) SERC School in neurosciences held during 7-21 December 2009 at IISER, Pune and c) SERC School in herpetology held during 2-7 November 2009 at Arya Vidya Peeth College, Guwahati. The workshops included SERC Workshop for promotion of research on wild life fauna of NE region held during 21-25 October 2009 at Guwahati University and Workshop on quantitative analysis & modelling in animal sciences held during 6-11 October 2009 at YASHADA, Pune.

New projects

Basic research in animal sciences was facilitated by funding individual and joint collaborative projects to scientists & technologists working in educational institutions, national laboratories and other recognised R&D institutions. Several new projects were funded in sub areas like ecology, faunal diversity, parasitology, aquaculture, toxicology, reproduction, development etc.

Ecology

The projects sanctioned include, the nutritional ecology of ant-plant mutualisms, comparative ecology of the house sparrow *Passer domesticus* in rural and urban landscape, macroecology of the terrestrial herpetofauna in Andaman and Nicobar archipelago, studies on the behavioural and community ecology of anuran tadpoles, and ecology of leopard *Panthera pardus* in relation to prey abundance and land -use pattern in Kashmir valley.

Faunal diversity

Morphological and molecular taxonomic investigations of locally available entomopathogenic nematodes (EPN) occurring in Barak Valley (Assam) and taxonomic study of endemic fish fauna of Chindwin and Kaladan river basins of NE India were commissioned.

Parasitology

Modelling spatiotemporal distribution of host-parasite populations and disease spread, characterization of genetic diversity of *E.sorbillans* and its symbiont *Wolbachia* and enhancement of parasitisation capacity of its parasitoid *N.thymus*.

Aquaculture

Characterization of digestive proteases of Indian major carps and its capacity to digest plant proteins, elucidation of role of retinoic acid in regulation of growth, reproduction and metabolism of edible crustaceans, and studies on ²-1, 3 glucan binding protein (²GBP)– receptor mediated cellular immune responses in the marine mussel *Perna viridis*.

Toxicology

Postnatal neurochemical and behavioural perturbations in rats following prenatal exposure to lead and studies on the impact of Bt toxin on soil microbes, nematodes, annelids and arthropods were funded.

Reproduction & development

The following projects were sanctioned. Ovarian vasotocin and vasotocin receptor genes: molecular cloning, characterization and expression among catfish and it's role in spawning activity, sex determination and gonadal differentiation in the Indian skipper frog, *Euphlyctis cyanophlyctis*- role of temperature in sex determination in anuran amphibians, functional studies on novel sex-specific lipoclains of hamster, and *in vivo* and *in vitro* studies on maturation of spermatozoa in the lizard, *Mabuya carinata*.

Achievements

Faunal diversity

Taxonomic study of the helminthes infecting freshwater food fishes with reference to their biodiversity revealed numerous undescribed trematode metacercariae of *Tetracotyle* group infecting various fishes. A new cestode larva of Cyclophyllid group has also been described.

Aquaculture

The study of biology of edible crustaceans *(Oziotelphusa sensex sensex*, *Scylla serrata*, *Macrobrachium rosenbergii* and *Penaeus monodon*) in relation to molting and reproduction revealed the involvement of eyestalks on the regulation of molting and reproduction based on eyestalk ablation studies. Biological activity was established for several eyestalk peptides. The CHH-family genes were isolated and cloned from the crab *Oxiotelphusa sensex sensex* and prawn *Macrobrachium rosenbergii*. Manipulation of expression of these genes would pave the way for enhanced growth and reproduction in edible crustacean species.

Reproduction and Development

Studies on structural and functional characterization of haemolymph factor(s) which mediate ecdysteroid action in insect revealed two heamolymph factors (HP19 & HP23) which play regulatory role during the postembryonic development. HP19 was shown to regulate ecdysteroid mediated actions like increase in acid phosphatase activity, phosphorylation of various proteins during the post embryonic development. HP23 plays important role in metabolism of ecdysteroid and regulation of ecdysteroid level

during the postembryonic development. *In vivo* immobilization of the HP19 and HP23 causes abnormal/ defective development/ metamorphosis and mortality of the insect. These could be used as potential target for the management of lepidopteran pests, which cause serious loss to agricultural produce.

Studies on delayed embryonic development in *Cynopterus sphinx* with implications of metabolic factors, demonstrated for the first time that the bat undergoes delayed embryonic development to facilitate the fat accumulation in *C. sphinx*. Fat accumulation in the bat is essential for their survival. The study confirms earlier observation of differential fetal growth in *C. sphinx* during two successive pregnancies of the year and demonstrates that the prolonged first pregnancy in winter is due to delayed embryonic development. The period of delayed development in November-December coincides with low BMR, low body temperature, low succinic dehydrogenase activity and fat accumulation.

Animal Communication

Characterization and behavioural correlates of songs and calls in the Indian chat *Cercomela fusca* and the pied bush chat *Saxcola caprata* revealed important characteristics of selected bird models which prove them to be suitable models in achieving a deeper understanding of the patterns and processes involved in acoustic communication network.

Biochemistry Biophysics, Microbiology and Molecular Biology

Department continued to promote growth in modern biology by providing support to basic research in the areas of biochemistry, biophysics, molecular biology and microbiology. About 35 projects were funded; 22 in academic institutions and 13 in research institutions. Research projects funded in the broad areas pertained to the following subjects :

Biochemistry

The projects currently under implementation aim to study: role of a core subunit of polymerase II, Rpb4 in transcription elongation, interaction of Leptin with endothelium and its implication in angiogenesis, screening of extracellular matrix protein derived cryptic bioactive peptides in regulation of cell activity, studies on marine anti-cancer compounds etc.

Structural Biology/ Biophysics

Under this sub area, structure of: plant lectins, DAHP synthase, RNA plant viruses, Methioninine aminopeptidase from MTb, chitinase from *Tamarindus indica*, brain energy metabolism of parkinson's disease by NMR etc. are under taken .

Molecular Biology

Genetics of primary microcephaly at molecular level, RNAi mediated silencing of key polyamine synthesis gene Ornithine decarboxylase for control of fungal pathogens and cancer, molecular and functional study of cerebellar ataxia (SCA 1, 2 and 3) in Zebrafish, hyaluronan Binding Protein 1 (HABP1) over expressing cell lines as a model to examine autophagy induction in tumorigenesis, signal transduction pathway involving the role of p66shc and RhoGTPase racl in neuronal cells etc. are being studied.

Plant Molecular Biology

The projects related to functional characterization of hydrolyzing enzyme from V*igna radiate*, studies on aldose reductase homologue gene in V*igna mungo* for drought stress tolerance, role of Ca+ calmodulin

dependent protein kinase in nodule formation in *Arachis hypogea*, genetic transformation in *Eleusine coracana* for salt tolerance by heterologous expression of Na+ -H+ antiporter gene; development of transgenic *Brassica Juncea* expressing normal and mutated edema factor gene for the development of vaccine against anthrax. etc have started.

Microbiology

The microbiological studies on bacillus lipase, phosphoprotein P and nucleocapsid protein N of Chandipura virus; protein translocation pathway from malaria parasite, Fumarate TCA cycle intermediate in *Plasmodium falciparum,* Arteether sensitive and arteether resistant protein from rodent malaria parasite, kinesin from *E. histolytica,* molecular studies on Glutahione utilization pathway of yeast, regulation of L-sorbose utilization in human fungal pathogen *Candida albican,* characterization of natural antimony resistance related gene(s) of L*eishmania donovani*.

Research outcome from some ongoing and completed projects were as follows:

Biochemistry

- Project on "Insights into pairing of meiotic chromosomes and recombination using yeast" suggested that Hop-1 protein, or its zinc-finger motif, play a key role in physical monitoring of recombination intemediates and branch migration of the Holliday junction. Hop-1, a component of SC, was the first protein shown to interact with the holliday junction and cause the symmetric distortion of its structure from yeast or any other organism.
- Results from "Identification of regulatory mechanism that monitor the formation of replication complexes" discovered that the eukaryotic replication protein RP1 is degraded after exposure to ultraviolet radiation.
- Studies on "SREBP mediated regulation of low-density lipoprotein receptor (LDLR), low density lipoprotein receptor-related protein (LRP) and receptor associated protein (RAP)" suggested that the hormones Insulin and Estrogen have regulatory effect on the expression of LDL-receptor(LDLR). The expression of either LRP-1 or RAP has not been found affected by these hormones.
- "Modulatory effects of herbal drug ingredient (S) on transcription factor pregnane & xenobiotic receptor (PXR)" analysed and summarized the following:
- Drugs that produce elevated level of PXR activity: Acacetin. Resvetrol, Guggulstrone, Forskolin, Kaempferol;
- Drugs that produce moderate level of PXR activity: Quercetin, Vincristine, Vinblastine, Hypercin:
- Drugs having no significant effect on PXR activity: curcumin, Capsacin, Etoposide, Catechin, silymarin, Anethol, Eugenol, Taxol, Digitonin, Camptothecin, Colchicine, p-coumaric acid.

Structural Biology

- The structures of proteins from two major protein classes: hemopexin and legumin were worked out. Structure of LS24 from *L. sativus* and CP4 from *V.unguiculata* presented the first hemopexin structures from plant kingdom, establishing and evolutionary link with mammalian hemopexin fold. The research proposed a mechanistic model explaning the functional significance of a novel plant

protein in plant stress physiology and polyamine metabolism. The work on the globular protein of *P. dulcis* gave definitive insights into the structural features associated with protein allegenicity.

- Jack bean and pigeon pea ureases were purified crystallized and diffraction data were collected. Structures of both the ureases were successfully determined.
- It was shown that intermolecular interactions were very important in both small molecule and macromolecular crystal structures. They play a crucial role in crystal packing and molecular recognition in drug receptor complexes.
- A method was developed to switch the specificity of a DNA-binding protein to a different target sequence using isosteric amino acid substitution. This technique may be useful for creating synthetic transcription factors with designed specificity.
- The mechanisms of folding and unfolding of the protein monellin were delineated. Important findings were reported on folding of single chain monellin and GroEL assisted folding of monellin. Research also provided direct evidence for a dry molten globule intermediate at initial stage during unfolding.
- For the first time cloning and expression of complete human GIP were carried out.
- Interaction between a substrate or inhibitor and its complementary a receptor were studied. This methodology can be gainfully exploited to design more tight binding inhibitors, with greater potency and efficacy.

Microbiology

- A novel protein complex formed by interaction of protein encoded by 3 previously uncharacterized ORFs of *S cerevisiae* (YFR044c, YBR281c and YNL191w) that function specifically in glutathione degradation was described. It was also suggested that both the alternative pathway and the y-GT pathway might be playing a very minor role; if any, in dealing with excess glutathione levels in the cell.
- It has been shown that the recombinant FAD synthetase enzyme from yeast can be purified and concentrated to its homogeneity level by optimizing the expression and purification protocol in *E.coli*. Also, for the first time the crystallization condition for the yeast FAD synthetase were identified.
- Research on "FtsZ as Antibacterial drug target" reported that curcumin induced filamentation in *Bacillus subtilis'* 168 cells suggesting that it inhibits bacterial cytokinesis. SepF (a septum forming protein) was cloned and purified for the first time ever. The results also suggested that the cysteine residue (Cys-155) of MtbFtsZ plays an important role in the assembly of MtbFtsZ into protofilaments. In addition, the polymers formed from MtbFtsZ are more stable than that of EcFtsZ.
- An important helicases from malaria parasite was characterised which will help in understanding the important process of nucleic acid metabolism in the malaria parasite.

DST intervention has been successful in consolidation of Indian researchers' efforts. Competence has been built in the area by training in emerging areas, which is reflected in the publications of research papers with high citations in high impact factor journals.

Health Sciences

During the year, the Department continued support to projects/ programme and activities on the cutting edge and frontline areas of Health Sciences. Several projects/ programmes were generated,

formulated and supported in high priority areas based on disease pattern of the country to strengthen the R&D knowledge base, generate baseline data, develop newer diagnostic methods, devices, processes and drug delivery system and study mechanism of action across 'different areas/ sub-areas' and 'institutions' with greater emphasis on fostering and promoting research and innovation to meet the rising health challenges ahead.

With the increase in life expectancy worldwide cognitive impairment and dementia are emerging as a major public health problem which present grave challenge to our society. During the year, several programmes initiated in the area of neurodegenerative disorders like Alzheimer's disease and Parkinson's and presenile dementia. Presently therapeutic regimens for neurodegenerative disorder are very limited and provide only marginal symptomatic relief. As in-depth understanding into the multiple mechanisms that contribute to cellular injury during oxidative stress would lead to paradigm shift in the approach for designing new attractive alternative viable therapies to either prevent or reverse the course of disease. A project was initiated to elucidate different mechanisms of amyloid ^{2} Protein (A ^{2}) toxicity in young and aged rat brain to understand the pathogenesis of Alzheimer disease in brain associated A ^{2} -42 accumulation, mitochondrial damage and oxidative stress. Another project on Presenilin (PS)1 and PS2 genes involved in brain development and function and their mutations which are associated with early onset of familial Alzheimer's disease (AD) was also initiated. Another project is being formulated to study the role of genetic polymorphism of drug metabolizing enzymes, CYP2PG, CYP3AU & UGTs in Alzheimer's patients.

The ubiquitin proteasomal system (UPS) has been shown to play central role in several neurodegenerative diseases. A project was supported to explore the therapeutic potential of heat shock proteins against the ubiquitin proteasome dysfunction in an experimental model of Parkinson's disease while another formulated to understand the patho-physiology and functional processes involved in various parkinsonian disorder like Parkinson's disease (PD), multiple system Atrophy (MSA) and Progressive Supranuclear Palsy (PSP) using functional MRI.

During the year, a collaborative multicentric study initiated on a rare disease called Limbgirdle muscular dystrophy (LGMD), an autosomal dominant genetic disorder. This a disease under the age of 16 years causing muscular disability in children particularly prevalent in South India, in view of the high degree of consanguineous marriages. It is proposed to profile the known genes of ARLGMD and also to identify novel genes for early diagnosis & better understanding of pathophysiology of the disease.

Another developmental disability affecting functions in children is cerebral palsy. A study has been initiated using MRD including diffusion tension imaging (DTI) metrics to assess neuro-psychological subtle changes in the micro-structural organization of white matter fibre tracts which indicate plastic changes in motor pathway. To design novel molecules with antidepressant potential in animals model(s) to exactly stimulate the clinical conditions of chronic and treatment depression. The expression profile of different neurotrophins level in specific brain areas and their receptor mediated signaling pathways is being studied in rat model to design new treatment modality to depression, targeting neurotrophin receptors and their signaling pathways.

The proteome profiles of endometriosis patients to understand pathophysiology of endometriosis for classification, diagnosis, management and treatment of this problem is being investigated. Post-menopausal bone loss leads to osteoporosis is being explored and project supported to develop Kaempferol (k), a flavonol, as a potential therapeutic agent for post menopausal osteoporosis. A project was initiated to

address the issues on the impact of sperm quality on embryogenesis. The system biological basis of expressional networks in endometrial receptivity for blastocyst implantation is being investigated.

Several projects initiated in the area of cancer Biology to delineate pathways for molecular basis of the disease. The role of molecular basis of deregulated folate transport on the methylation status of global genome and important tumor suppressor genes has been evaluated. Another project to analyze the structure and function of ERG oncoprotein, a transcription factor of the ETS family involved in prostate cancer to design drugs based on structure and function of this protein started. With the recent advances in genomic technology, high density SNP micro-arrays are being used to determine alteration in the whole genome which not only can detect genomic gains or losses, but has the advantage of detecting copy number neutral LOH (Loss of heterozyygosity). Cervical cancer is associated with recurrent chromosomal aberrations. A study to identify putative biomarkers for progression of the disease as well as response to therapy in cervical cancer has been initiated.

The expression and activity of MMP-2 in various stages of oncogenes is being explored to understand role of MMP-2 in breast cancer development. To elucidate the status of gene-methylation as an early marker for cancer/ risk assessment and its response to anticancer agents, a study is being initiated. The study is designed to understand the time dependent changes in the DNA methylation that could be associated with tumor development.

A collaborative study between two centres started for development of an interesting group of anti-cancer agents as 2-chloroethyl nitrosourea derivatives of substituted nathalimides possess excellent *in vivo* anticancer activity against lung cancer cell lines. Among many upcoming anticancer treatment modalities, a study has been initiated inducing senescence in tumor cells to explore role of heat shock proteins in cellular senescence.

Therapeutic options for the effective treatment of visceral leishmaniasis are limited and carry the burden of toxicity. Two plant derived anti-leishmanial compounds (Artemisin and Berberine cholorine) that generate free radicals with the Leishmania Parasite culminating in an apoptosis like death are being investigated. The effect of these compounds upon the antioxidant pathways of Leishmania parasites would be studied. Two plants *Rheum emodi and Achillea millefolium,* known to possess good activity against various human pathogens, have been explored for treatment of sepsis. A study has been initiated to evaluate and adoptive standardize the molecular technique of PCR for rapid diagnosis of bacterial and fungal endopthalmitis cases.

Cryptococcorris is a major, potentially fatal systemic mycosis of worldwide distribution frequently occurring in patients with AIDS and other immuno-deficiencies. The genetic heterogenicity and ecology of *Crytococcus neoformans* and *Crytococcus gatti* are being studied. Using tools of genomics and proteomics to understand in-depth how ESAT-6 interacts with its cell surface receptor TLR-2, the repertoire of innate immune effectors that it modulates, the signaling pathways triggered by ESAT-6, and whether other members of the ESAT-6 family are endowed with similar capabilities being investigated. Studies under progress on Epidemiology of fungal rhinosinusitis in North India. Chandipura virus (CHPV) is known to cause a sever form of encephalitis. Studies are under progress on the interaction of CHPV proteins among themselves and with the host proteome.

There is increasing trend globally of lifestyle diseases such as diabetes, cardiovascular disorder. A study has been initiated on Inositol phospholipid signaling into the mechanisms of beta cell death and

plausible therapeutic targets of diabetes. Atherosclerosis is an excessive inflammatory/ proliferative response of the vascular wall to various forms of injury. A project was initiated to study role and involvement of different physiologically formed ROS and RNS in causing endothelial and vascular smooth muscle cell death/ proliferation. Another project has been designed to investigate the influence of glucose levels on the toxicity of antihypertensive drugs and the intervention of agents for the ameliorative effects. Studies are under progress to evaluate sleep abnormalities in people with juvenile myoclonic epilepsy (JME) syndrome and to determine whether sleep architecture is modified in these patients.

Role of micronutrients in the development and prevention or delay of diabetic retinopathy is being studied. To provide conclusive evidence on existence of autonomic dysfunction in chronic obstructive pulmonary disease (COPD), studies are under progress based on the phenomenon of Heart Rate variability (HRV) and its relation to severity of disease. A project to explore the viviparous bengalensis (fresh water snails) flesh extract in experimental osteoarthritis (OA) and osteoporosis (OP) model the active constituents and mechanisms action is under progress.

The Department is continuing support to activities related to human resources development with a specific aim to motivate clinicians towards basic research, facilitate interaction of basic research scientist with clinicians and promote R & D in vital areas of health sciences. Five such workshops have been organized during the year:-'Techniques in Animal Cell Culture, Live Cell Functional Imaging and Neurotransmitters Receptors Functional Regulation, Cytopathology and HPV testing at the 4th Biennial conference of the Asia Oceania Research organization of Genital Infection and Neoplasia (AOGIN), Applications of Bioinformatics and Proteomic Techniques in Neurobiology, Hands on training workshop on Advance Molecular Biological techniques including Microarray, Real Time PCR and 2D electrophoresis.

Studies were initiated in characterisation of Pneumococcal serotypes that colonise the nasopharynx of Indian infants and their role as a risk factor for acute supportive otitis media, to understand the pathogen developmental patterns from infants onwards. Results of the study on development of molecular and genetic markers of virus transmission competence of dengue vector species in Rajasthan, indicates that 200 kDa protein composed of special terminal amino acid could be the blocking protein for internalization and further replication of dengue virus for mosquito cells.

The Mechanism of T cell signaling in leprosy patients by *M.leprae* antigens for understanding of events in regulating pathways/ molecules / new antigens involved in the immunosuppression or immunopotentiation in leprosy patients being studied. By using the inhibitor(s) of a pathway responsible for the energy seen in leprosy patients it might be possible to modulate the immune response. Two promising lead molecules effective against adult bovine filarial worm *Setaria digitata in vitro* have been identified for antifilarial drug development.

Studies are underway for the Identification and molecular characterization of bacterial flora in Inflammatory Bowel disease to dissect out the signalling pathway affected due to mutations in the NOD1 gene. *Culex tritaeniorhynchus* was incriminated as the major JE vector. Baseline data of this major vector was collected from these areas. Studies shows porin to be an effective adjuvant that triggers the immune cells for a polarized innate immune response. Moreover, porin of *S. dysenteriae* determines a specific immunologic outcome for its ability to shepherd T lymphocytes into Th1-dominant phenotype, thereby successfully bridging the innate and adaptive immunity, as required of an adjuvant. Results of the study on molecular epidemiology of hepatocellular carcinoma reveal that concomitant HBV or HCV infection was associated with increased risk of HCC, as expected; the risk of HCC increased amongst heavy

drinkers from Madurai with respect to GSTM1 polymorphism whereas genetic polymorphism in GSTT1 influences HCC risk with respect to cigarette smoking from New Delhi. Studies using genomic microarray, revealed that Parasite Surface Antigen -2 (PSA-2) genes was up-regulated in antimony resistant Leishmania investigated. The role of PSA-2 of L. donovani in drug resistance using genetically manipulated parasite has been investigated.

The evaluation of the chemopreventive potential of neem (*Azadirachta indica*) leaf fractions in the hamster buccal pouch carcinogenesis model revealed that the both azadirachtin and nimbolide exhibited concentration-dependent antiradical scavenging activity and reductive potential in the order: nimbolide >azadirachtin >ascorbate. On a comparative basis, nimbolide was found to be a more potent antioxidant and chemopreventive agent and offers promise as a candidate agent in multitargeted prevention and treatment of cancer C. peraari. extract reduces the tumor incidence and changes in energy metabolism and also shows anticancer potency.

Chronic hyperglycemia increases germ cell apoptosis in male gonads. Studies have demonstrated that germ cell death by apoptosis as well as germ cell detachment from seminiferous epithelium in STZ-induced diabetic rat testis, leads to male infertility and its rectification by MTEC treatment. The percentage seropositivity detected in CAD patients for C.pneumoniae specific IgG, IgA were significantly high compared to controls. The level of hsCRP, an independent proatherosclerotic marker was also higher only in C. pneumoniae IgA positive patients. There is strong association of Chlamydia pneumoniae infection in CAD patients observed. Preliminary results on study to investigate the role of dietary agents against T2D-induced cataract indicate that chronic insulin resistance may lead to lens abnormalities. There is a significant association found between diabetic retinopathy and lowered levels of vitamin B-12 and manganese.

Results of the study on non syndromic hearing loss patient's, reveal that the frequency and distribution of Cx26 mutations in our North Indian cohort differ from those previously reported in Indian patients from South India. Neurotransmitters- cholinergic, dopaminergic serotonergic and gabaergic receptors subtypes showed functional difference in brain regions of diabetic and insulin induced hypoglyceamic diabetic rats. Gene expression studies and confocal calcium imaging in combination with second messengers and transcription factors confirmed their role in insulin function.

Epidemiological data suggests a causative link between a preventable habit of arecanut chewing with or without tobacco (Pan masala/Gutkha) in the manifestation of oral submucous fibrosis (OSMF). The data suggests differential expression of several novel genes between normal and OSMF tissues and one of the principal genetic pathways involved in the manifestation of this disease is, "Transforming Growth Factor-beta pathway". The study also showed that arecoline, a principal component of arecanut has profound effect on the gene expression of both epithelial and fibroblasts. Results demonstrated that epithelial factors regulated by arecoline are important for promotion of this disease suggesting that stromal-epithelial interactions are essential for manifestation of OSMF.

Tissue culture studies were carried out using the scaffolds prepared. Tissue culture studies revealed that corneal epithelial cells could be grown on the scaffold prepared from cross-linked collagen matrix isolated from chrome shavings (Bovine source). Similar results were observed with collagen matrix prepared from the fish scale collagen. Excellent growth of corneal epithelial cells was observed on the surface of aluminum sulphate cross-linked HAM.

Uveal melanoma is the most common intraocular primary tumor, involving iris, ciliary body and choroids. A significant correlation was observed in monosomy 3 and 1p36 positive cases in the tumor samples

(p=0.039). MicroRNA expression profiling revealed the presence of 19 miRNAs expressed in non-metastasizing melanoma and absent in metastasizing melanoma. Eleven miRNAs were found to be expressed in metastasizing melanoma and absent in non-metastasizing melanoma. Genes targeted by the miRNAs were found to be present in chromosomal regions 8p22, 13q, and 17p but were often found to be deleted. Initial studies on microRNA have revealed their role as oncomirs in both metastasizing and non-metastasizing melanomas. Further studies may provide insights into their role in tumor progression and facilitate metastatic phenotype analysis.

The Expression of Human Papilloma virus (HPV) in Oral submucous Fibrosis being studied. The preliminary observation revealed that 31.4% OSMF samples found positive of HPV virus. Observations based on the genotyping results suggest that there is higher frequency of the heterozygous genotype (AG) as compared to healthy controls. This association is even stronger in patients with Lupus nephritis. Similarly, FcG2A R/H RH mutant allele appears to be associated with SLE susceptibility. In contrast, ACE DD genotype in SLE patients may be associated with non progression to lupus nephritis (it may be protective). No association found of TNFa -308 and TNFa-238 promoter region polymorphism with SLE susceptibility.

Three single nucleotide polymorphisms and one variable number of tandem repeat markers in the GRIK1/GluR5 gene were characterized in the control and Down syndrome family samples. Moderate heterozygosity (0.34) and a major allele frequency of 0.78 render the 1173(C/T) polymorphism informative. Estimated ratio of meiosis-I to meiosis-II errors arising from allelic non-disjunction of 1173(C/T) is 4:1 in maternal cases and 2:1 in paternal cases suggesting that cellular context of chromosome segregation confers varying risk of non-disjunction. The (GATA) n VNTR marker is less informative in our population study group and allele frequencies deviate significantly from Hardy Weinberg equilibrium.

Nano ribbons of HAp/collagen composites and nano fibers of Hap which were obtained at room temperature were developed . In addition, synthesized of resorbable triphasic HAp/ (± and ²) TCP composite at low temperature which could be used as bone and dental replacement material. Developed Iron doped hydroxyapatite which showed better heamobiocompatibility and drug release whereas lanthanum doped HAp show *in vitro*, initial burst of drug release followed by the controlled release. Calcium phosphate and their polymer composites, developed could be used for preparing bone replacement, drug delivery and tissue engineering applications. The novel salt forms of prazosin: Prazosin or esylate and camsylate have been characterized as the suitable candidate for further evaluation.

Results of the study on tight junction proteins reveal that there was an under expression of Zo-1 in mucosal epithelium of villi and crypts in treatment naïve celiac disease and active Crohn's disease in terms of distribution of staining in comparison to controls. There was a normalization of ZO-1 expression 6 after gluten free diet in celiac disease as well as in Crohn's disease after treatment. There was over expression of claudin-2 in the mucosal epithelium in treatment naïve celiac disease and active Crohn's disease compared with controls, the expression of which got down regulated 6 months after treatment. There also was under-expression of claudin-4 distribution in treatment naïve celiac disease and active Crohn's disease in comparison to controls. There was over expression of Occluding in treatment naïve celiac disease and active Crohn's disease, but there is no significant difference in occluding and claudin-4 expression 6 months after treatment.

The prokaryotic proteasome system ClpQY from the parasite genome identified. Both the PfClpQ and PfClpY genes were cloned and corresponding recombinant proteins was expressed. Both the proteins were localized in the cytosol of the parasite as a soluble protein. Techniques for production of active recombinant PfClpQ protease and to carry out in vitro protease assays have been standardized; this can

be used for high-throughput screening of compound libraries to find out specific inhibitors as potential lead compounds to develop anti-malarial. Quantitation of MRD by RtPCR detected relapse 2 months prior to clinical relapse. Studies are underway to translate this technique to clinic Genotyping of GST, MTHFR, RFC, TPMT any CYP1A1* 2A in all patients.

A 29 Kd galactose terminal protein was purified and expressed in the mammalian, E-coli and leishmania vectors. The recombinant protein was purified and its efficacy studied. Apoptosis of macrophages plays an important role in the immune response to mycobacterial infection. Studies showed that the inhibitor of apoptosis, FLIP is degraded after phosphorylation by c-Abl and p38 MAPK in a c-Cbl E3 ligase dependent manner after mycobacterial infection. Degradation of FLIP is associated with macrophage apoptosis which may modulate mycobacteria induced infection. The findings of the studies provide new insight into the mechanisms of mycobacteria-mediated apoptosis. Any intervention in this process could modulate the course of the disease.

Plant Sciences

In the area of Plant Sciences several projects have been supported to strengthen basic and application oriented programmes. The support was provided in cutting edge/frontier areas as well as traditional areas such as taxonomy, etc.

During the year, research projects were sanctioned in the area of Reproductive Biology, Bioprospecting, Ex situ conservation of medicinal and wild species of plants of economic importance. Molecular characterization, Marker assisted selection of resistance gene, Biotic and abiotic stress, Biocontrol, Plant microbe interaction and Mycorrhizal relationship, Entophytic fungi and various aspects of Stress proteomics and Functional Genomics of Abiotic Stress Responses in Nitrogen-fixing Cyanobacteria etc. and National Training Program/Workshop on Traditional and Modern Approaches in Plant Taxonomy at Bangalore.

Findings from the projects funded under the programme revealed:

Significant results were reported in the project titled "Molecular analysis of AhpC (alkyl hydro peroxide reductase) in offering abiotic stress tolerance in *Anabaena* sp. PCC 7120" being implemented at Banaras Hindu University.

AhpC protein over expressed in heat stressed *Anabaena doliolum* is a key component of a large family of antioxidative proteins and harbors all essential qualifications as a protective protein against multiple abiotic stresses by scavenging ROS. In view of this it was hypothesized that *ahpC* transformed cyanobacteria might fix nitrogen in the presence of a multitude of abiotic stresses. The *ahpC* gene has been cloned, over expressed in *E.coli* (BL 21) and screened for stresses like salt, heat, UV, Cd, Cu and pesticide for the first time.

The *ahpC* gene has now been cloned in *Anabaena* PCC 7120 using vector (pFPN) and its functional characterisation is in progress.

Summary of Progress

Title: Understanding the role of epigenetic elements in controlling floral-organs development by methylome profiling using high density microarrays in rice. Starting with the objective to understand the effect of DNA methylation dynamics on transcriptome alterations during male gametophyte development,

we have characterized structural aspects and expression dynamics of rice Argunaute (*OsAGO*), Dicer like (*OsDCL*) and RNA dependent RNA Polymerase (*OsRdRP*) genes that have been implicated in small RNA based silencing of gene expression was characterized. Furthermore, by using 57 k rice whole genome microarrays, it was found that at a given stage about 69% of the rice genes exist in hemi-methylated state, whereas, 17% genes are not methylated at all and 14% genes are heavily methylated (Figure). When compare between the pre-meiotic and meiotic stages of anther development only ~30% genes were found to be commonly methylated, whereas, methylation status of ~70% genes changed between these two stages. And since data revealed a positive correlation between methylation status and gene silencing, it seems that epigenetics plays an important role in regulating development-dependent gene expression patterns.

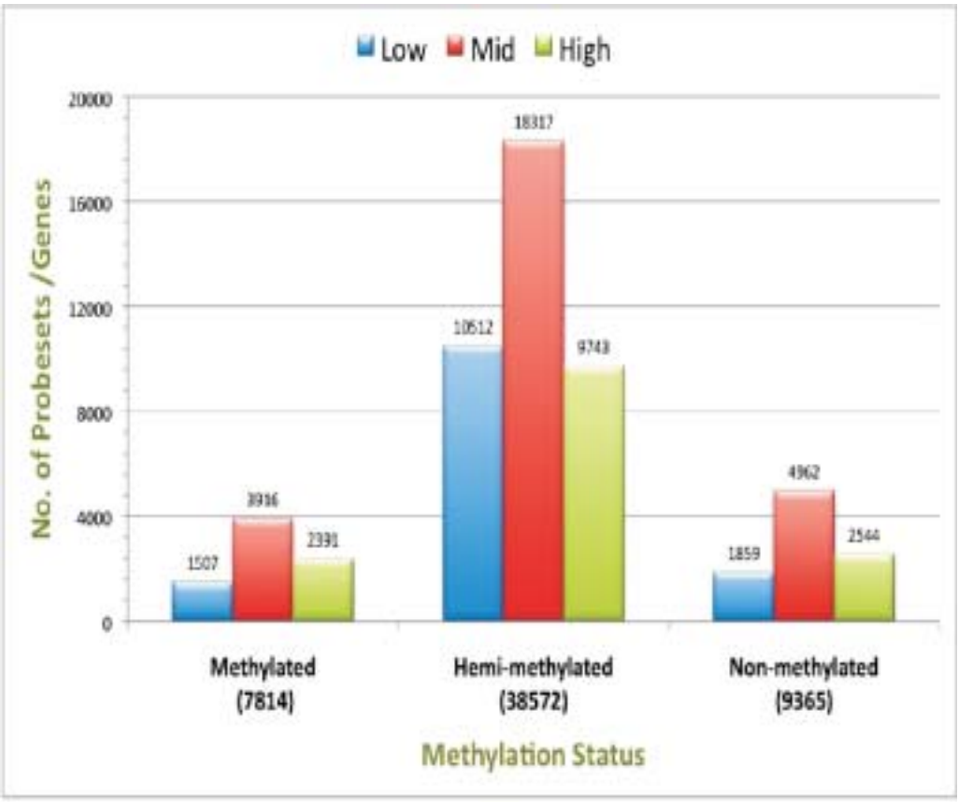


Figure : Methylation Status of Rice Genome

Title "Free radical scavenger and antioxidant activities of selected north western Himalayan medicinal plants". Thirty six medicinal plants growing in north-western Himalaya belonging to 25 families namely *Terminalia belerica, Terminalia chebula, Emblica officinalis, Albizia lebbeck, Acacia catechu. Cinnamomum camphora, Cinnamomum tamala, Picrorhiza kurroa, Syzygium cumini, Oscimum sanctum, Oscimum basilicum, Ocimum kilimandscharicum, Oroxylum indicum, Aegle marmelos, Curcuma longa, Bacopa monnieri, Murraya Koenigii, Gmelina arborea, Aloe vera, Prunus cerasoides, Centnella asiatica, Tinospora cordifolia, Coriandrum sativum, Achyranthes aspera, Fumaria parviflora, Ajuga bracteosa, Daucus carota, Celastrus paniculatus, Boerhavia diffusa, Withania somnifera, Catharanthus roseus, Acorus calamus, Piper longum, Asparagus adscendens,*

Asparagus racemosus and *Raphanus sativus* were investigated for antioxidant activity. Following observations were made.

- It was found that the fruits of *Terminalia belerica*, *Terminalia chebula*, *Emblica officinalis*, bark of *Albizia lebbeck*, heartwood of *Acacia catechu* showed extremely high antioxidant activity which was comparable to standard antioxidants such as tocopherol and butylated hydroxy toluene (BHT).
- A significant and linear relationship was observed between the antioxidant activity and phenolic content indicating that phenolic compounds are major contributor of antioxidant activity of these medicinal plants.
- Qualitative and quantitative profiling of phenolic compounds using High Performance Liquid Chromatography (HPLC) revealed higher level of gallic acid in 28 out of 36 medicinal plants investigated.

***Terminalia belerica* (Fruit)**

***Terminalia chebula* (Fruit)**

Further studies on Indian Zingiberaceae

The taxonomic Revision of the family Zingiberaceae was carried out. The major outcome of the study includes:

a) Two genera new to India were described.

b) Two species and two varieties new to science were discovered.

c) Three species new to India were described.

d) Seven papers were published in International and National Journals and also presented 8 papers/ posters in Seminars/Symposia in India and abroad.

e) Digitalized 2144 Number of herbarium sheets of the family in India with correct identification and developed a software for easy retrieval.

f) Developed the largest live ginger germplasm and herbarium collection in India and third largest in the world.

g) Developed a digitalized flora of the family for the first time.

Project Title: Physical Mapping of Simple Sequence Repeats (SSRs) in Bread Wheat

Physical maps of 21 bread wheat chromosomes containing 1,376 genomic SSR and EST-SSR loci were prepared. These maps were integrated with the available physical maps of bread wheat leading to the construction of integrated physical maps of the 21 wheat chromosomes containing a total of 2,148 SSR loci. The markers in the physical and the genetic maps (used for comparison) were collinear except for a few discrepancies. The physical maps can be used as an anchor point for the physical BAC contig map of wheat genome. EST-SSRs mapped may serve as "perfect markers" in future studies in the project.

ENGINEERING SCIENCES

The extensive programme objectives of Engineering Sciences cover support to research efforts in a range of various disciplines within engineering sciences such as Civil, Chemical, Electrical, Computer, Material, Mining & Mineral, Mechanical Engineering, Robotics and Automation. The individual research programmes may address one or more sectors namely, health, bio-medical, transportation, automotive, water resources management, structural engineering, building technologies, manufacturing and process industry related technologies, etc. However, of late few proposals under this programme do reflect the inter-disciplinary nature that research activities are now taking. In addition few major proposals have been received for setting up of Engineering Research Centres in many academic Institutions.

During the year, support to both basic and applied research was continued. 190 new research projects at a cost of Rs. 3120.2 lakh have been initiated / identified for support. The Committees regularly monitored the progress made in ongoing projects. Several interesting and significant results reported from these individual engineering science programmes, are given below:

Chemical Engineering

Chemical Engineering Programme (CEP) continues to be a front runner amongst peers in terms of new initiatives and operational parameters. Salient features of the output generated from a basket of about 100 ongoing projects and 35 new projects (sanctioned during current financial year) are reported as follow.

- Designed cobalt based heterogeneous catalysts for the liquid phase oxidation of p-cresol which an industrially important oxidation reaction as well as a model reaction for understanding the oxidation of side chain phenols. Developed cobalt oxide (Co_3O_4) heterogeneous catalyst which gave complete

conversion of p-cresol with a selectivity to PHB as high as 95% under elevated pressure conditions. A novel catalyst involving intercalated cobalt-Schiff base complexes into the montmorillonite clay was also developed, which gave a selectivity of 90% to the oxyfunctionalized products under ambient pressure conditions. Complete characterization of this catalyst system was done by XPS, DR-UV, XRD, FT-IR, SEM-EDX. The research related to the project has resulted in 7 International Journal publications.

- Developed a three step method for synthesis of asymmetric clay-zeolite-glass composite membrane. The first step involves synthesis of macroporous clay support obtained by sintering clay mixture and in the second step the active mesoporous layer is obtained by partial blocking of the mouth of pores of clay support by zeolite particles by dip coating technique and the third step includes coating of the zeolite layer with glass layer. Surface morphology is studied using SEM. The variation of membrane potential with pH shows that membrane potential increases with pH. The static transport numbers are 0.914 and 0.791 for glass-zeolite-clay and zeolite-clay based membranes respectively. The research related to the project has resulted in an International Journal publication.

- Hybrid strategies involving synergistic combination of Wavelet Transformation, nonlinear dynamics theory (mean local Hölder exponent formalism) and Support Vector Machines were employed for characterization of process, biological and biomedical signals. The distribution of local singularities of a time series can be employed to pick up its unique signature. Hence, the features of the singularity distribution of different time series were employed for identifying the class and function of process/ biological/ biomedical signals of a time series. Wavelets were used as a mathematical microscope to enable identification and computation of and local Hölder exponents (singularity spectrum) profiles. The ability of wavelet transform to reveal the hierarchy of singular features was found to be particularly advantageous to tackle the problems at hand. The research related to the project has resulted in 11 International Journal publications.

- Flow regimes in gas-liquid and liquid-liquid flow in micro-channels were studied. Key hydrodynamic parameters such as bubble/liquid slug velocities/ lengths were determined using the high speed digital imaging. Pressure drop values for the range of flow rates were measured for different systems. Developed a CFD model based on unit cell approach to simulate slug flow in a capillary. A novel mesh microreactor resembling a structured fixed bed reactor with benefits both of conventional fixed bed reactor and microreactors is developed. This system is easy to build and does not need precision micromachining.. RTD in liquid phase were studied using conductivity probe. The RTD and the image analysis for all the mesh types, showed hysteresis in the flow and mixing in mesh microreactor. General purpose models based on first principles were developed for gas-liquid (GL) and gas-liquid-solid (GLS) reactions in micro-channels. The model was used to simulate chlorination and hydrogenation reactions. A computational fluid dynamics (CFD) model based on free surface methodology, volume of fluid (VOF), was developed. The model was used to develop understanding and guidelines to design contact angle and geometry mediated micro-devices. The research related to the project has resulted in an International Journal publication.

Electrical, Electronics and Computer Engineering

Twenty Eight projects were sanctioned during current financial year. Some of salient features are reported her out of the 100 ongoing projects.

- Developed new designs for transmitter antenna based on parasitic superstrate patches. Observed the impact of varying dielectric constant on the performance of such antennas. Studied the impact of patch array size, spacing and patch dimensions on the performance. Proposed a new circular array based superstrate antenna. Designed a new Distributed Voltage Controlled Oscillator (DVCO) on cascade topology and bias variation. Designed a Ku band DVCO and Travelling Wave Amplifier (TWA). The research related to the project has resulted in 2 International Journal publications.

- Developed a new multilevel inverter topology for induction motor. Unlike conventional hexagonal space vector PWM pattern, this inverter produces 12-sided polygonal space vector structure throughout the modulation range. In order to minimize the dv/dt stress on the devices and improve the harmonic spectrum of phase voltage, at lower speed operation the inner 12-sided polygon is used, while for higher speed outer 12-sided polygon is used. This eliminates all 6n±1 harmonics (n=odd) from the phase voltage apart from highly suppressing the lower order harmonics. Besides, the linear modulation range can be extended upto 96.6% of the base speed of the motor, which can extend smoothly into over-modulation and final 12-step operation without any special compensation schemes. Throughout the modulation range the inverters are operated less than output phase voltage switching frequency, with the high voltage inverter always switching at nearly half the output phase voltage switching frequency. The research related to the project has resulted in an International Journal publication.

- Fabricated Miniaturised Electrolyte Insulator semiconductor capacitor (EISCAP) sensors with volume of 0.1-0.2 µl by bulk micromachining of p-type silicon. The enzyme lipase has been immobilized on the mini EISCAPs and they have been used for triglyceride sensing. Measurement circuit has been fabricated on breadboard and measurements using this with miniaturized EISCAPs showed good agreement with commercial pH meters. The research related to the project has resulted in 1 International Journal publications.

- QKD is a viable method for key exchange for transmission of highly sensitive information that requires security that is better than the security provided by trusted third parties or other human methods. Demonstrated Experimental transmission of bits using coherent optical states (less than 1 photons per pulse) over a long fibre spool. Designed and implemented Efficient low-density parity-check codes for reconciliation. Developed single photon detector, narrow linewidth Fabry-Perot Fibre Bragg Grating filter, dispersion measurement unit over 25km of optical fibre and femto-second active mode-locked Er-doped fibre laser. The research related to the project has resulted in 2 International Journal publications.

Material, Mining & Mineral Engineering

During the year, support to both basic and applied research was continued. 26 new research efforts have been initiated / identified for support and another 22 are under evaluation.

Research efforts supported / identified for support during the year include the following:

Studies on deformation behaviour of carbon nanotube filled polymer nanocomposites based on crack propagation kinetics and strain field analysis approach

Effect of Cryorolling on the Precipitation Kinetics of Selected Ultrfine Grained AI Alloys

Synthesis & bioactivity studies on substituted-hydroxyapatite coating for biomedical applications

Generation of improved photovoltaic devices for making efficient dye sensitized solar cells

Iron Aluminides Containing Carbon

Development of supercapacitor using carbon nano material synthesized from plant based precursor

Development of a model for the Assessment of spontaneous heating susceptibility of Indian coals-a neural network approach

SERC Summer School on 'Mineral Technology'

Development of sulphate reduction technology in an anaerobic digester for abatement of acid mine drainge

Fuctionallized polymer nanocomposites for organic photovoltaic devices

Effect of repetitive strain and anneal on microstructure and mechanical properties of metastable austenitic stainless steel

Weldability studies on sintered and forged low alloy steels

Hexavalent chromium detoxification by microbial isolates from a specific chromium mining site and bioremediation application potential:a laboratory based study

Study of Materials characteristic of complex alloyed tool steel at cryogenic temperature

Development of alloys with Gegapascal Strength using Nanometric Eutectic Microstructure

Design and study of high thermal cycle life thermal barrier coatings

Effect of chemical, microstructural and morphological modifications of the nano titania photoanode on the performance of dye sensitized solar cells

Magnetic nanoparticles decorated biodegradable polyurethanes /MWCNT nanocomposites as shape memory materials

White Organic Light Emitting Diode for Lighting and Displays

Development of Ultra High Purity Gallium for Epitaxial Electronic and Optoelectronic Applications

Development of Calcium Sulfate Based Injectable Bone Substitute

Ionic Liquids as solvents for the Electrodeposition of Chromium, Zinc, Nickel and Aluminium.

Experimental and Numerical Investigations on the Mechanical Behaviour of Micro-sized Structural Elements

Synthesis of oxide based magnetic nanoparticles for biocompatibility studies, magnetic hyperthermia and MRI applications

Preparation of M_3AX_2 phase ternary carbides and fabrication of its nanocomposites through novel methods

Synthesis of Nano Tungsten Carbide Powder from Wolframite Ore

Highlights of results accruing from research efforts initiated during preceding years:

- A new coal wash-ability index, termed as 'Near Gravity Material Index (NGMI)', was formulated based on the sink-float data at RRL Bhopal. An appropriate model to quantify the wash-ability characteristics of coal was developed using 'Near Gravity Material Index (NGMI). The proposed approach of evaluating the performance of any gravity based coal washing equipment is based on direct comparison of product quality and quantity with the feed coal quality and quantity targeted and therefore, more practical. Hence, optimization of process and design variables of any gravity based equipment to process a typical coal can be done by carrying out limited experiments.

- Study on life Enhancement of Hydro Turbine Components by Surface Coatings was carried at IIT, Chennai. Silt which was collected from Manani River was utilized to asses the erosion performance of Stellite and Colmonoy 88 LSA deposits. Laser surface alloying (LSA) was done with optimum height, width and depth on 13Cr-4Ni steel with Colmonoy 88 and Stellite 6 powders. The characterizations of LSA steels have been studies. Maximum hardness achieved in the case of Colmonoy 88 was in the range of 600-650 HV, where in Setellite 6 coated LSA steels showed 400-500 HV. As much as 4 fold increase in slurry erosion resistance (expressed in terms of mass loss) of LSA steels was observed as compare to uncoated 13Cr-4Ni steel. At least 20-30% decreased in erosion rates were obtained when impacted with river silt compared to commercial SiO_2 impacts.

- Synthesis of few advanced nanocomposites was carried out at Anna Univerisity, Chennai such as hydroxyl terminated polydimenthylsiloxanes, cyanate terminated silane-coupling agents and cyanate esters. Characterization of theses composites for their thermal, mechanical, electrical and U.V. radiation resistance by ASTM methods were conducted. Nanocomposites were prepared by thermal curing and solvent casting method. Preparation of nanocomposites by the combination of Cyanate ester and polyhedral oligomeric silsesquioxanes (POSS) shows an excellent radiation resistant material. And these nanocomposites can be used as a radiation resistance coating material and also can be used to form advanced nanocomposites as matrix materials.

- Porous inject able ceramic bone cements were prepared at, IIT Chennai.

  The biphasic calcium phosphate (BCP) a combination of Hydroxyapatite (HA) and tricalciumphosphate (TCP) with naturally derived polymers such as chitosan, and gelatin as carrier gel with controlled degradation profiles for bone tissue regeneration. Detailed phase evolution and microstructural studies were carried out. Particulates of BCP in certain HA/TCP ratio with a natural polymer (carrier gel) were prepared so that material become inject able. The bioactivity of the cements was characterized by measuring apatite formation as a function of time using scanning electron microscope.

- Plasma assisted Metallorganic Chemical Vapour Deposition facilities were designed & fabricated indigenously at Loyola College, Chennai. Several complexes of yttrium and zirconium were prepared and characterized by quantitative analysis, elemental analysis, FT-IR, mass spectral analysis, TG-DTA (non-isothermal) and mass transport (Vacuum studies). Several metallorganic compounds were synthesized by modified methods. They were screened and except $Al(acac)_3$, $Y(tmhd)_3$, $Y(tmhd)_3$. diglyme, $Y(tmhd)_3$.triglyme, $Zr(tmhd)_4$, and Cp_2ZrXl_2 were found to be unsuitable in terms of volatility and thermal residue. The successful depositions of Y_2O_3, Sc_2O_3 thin films were deposited on various substrates like glass, Si, alumina, graphite and quartz.

- Development of thermosetting polymer/clay nano-composites were made at Tezpur Univ., Napaam Tezpur Hyper branched and conventional resinous polyurethane were synthesized from a sustainable natural resource, Mesua ferrea L. seed oil. The physical as well as mechanical properties of the epoxy cured polyurethanes were investigated and further these polymers were used as matrices to prepare different nanocomposites. A variety of nanofillers such as nanoclay, metal nanoparticles, carbon nanotube, were introduced in the matrix using different techniques. Enhancement of the properties like tensile strength, impact strength, scratch hardness, adhesion strength, thermal stability, shape memory, water vapour barrier properties were observed by incorporation of nanoclays in both the hyperbranched and conventional polyurethane systems. These hyper branched and conventional resinous polyurethane clay nanocomposities deserve the potential to be utilized as advanced surface coating, adhesives and biomaterials.

- Friction pads for brake disc employed in modern heavy duty automobiles/ commercial and fighter aircrafts are being developed at IIT, Roorkee. Few samples of friction pads with built-in backing plates for the MIG 27 & AN-32 military aircraft were developed employing hot powder forging technology. The technique involves mixing of powders of suitable chemistry having metallic constituents, abrasives and solid lubricants in specific proportions. The forged friction material was subjected to variety of tests including sub-scale dynamometer test at HAL Bangalore. Efforts are being made to develop brake pads by hot perform powder forging (net-shape) without involving any machining to optimize the manufacturing cost to the minimum level. MIG 27 stator application is very specialized high energy condition for which chemistry of sintered pads is very complex and costly. In comparison to this, chemistry being developed in the present investigation is much simpler and offer wide variety of choices to suit this challenging application.

- Studies on ambient and elevated temperature properties of joints of metals prepared by adhesive joining using nano-particle filled adhesive are being under progress at IIT, Roorkee. A new class of epoxy based adhesive has been prepared by homogeneous distribution of practically cluster free nano (20-30 nm) particles of SiO_2 and ZrO_2 in the matrix using ultrasonic cavitation technique. Various fundamental aspects of conventional and ultrasonic processing technology were considered in synthesis of nano composite epoxy adhesive. The standard test procedure was used to study the fracture toughness, lap shear strength, and tensile strength of the nano composite adhesive and its adhesive joint as well as their fracture behaviour. The use of ultrasonic mixing process produces well dispersed non agglomerated ex-situ prepared nano composite epoxy adhesives. The resin properties of epoxy are significantly influenced by ultrasonic mixing with nano particle loading. Fracture toughness of ultrasonically treated ZrO2 nano composite epoxy adhesive was raised to maximum of 2.01 $MNm^{-3/2}$ which is considerable higher than the same composite adhesive produced by conventional mixing as well as SiO_2 loaded epoxiy adhesive prepared by both the mixing processes.

- Three new series of poly (ether imides) novel polymer nano-composite membranes were successfully prepared at IIT Kharagpur and their gas permeation properties were measured for four different gases like CH_4, N_2, O_2 and CO_2. High permeability of CO_2 and high selectivity for CO_2 over CH_4 were achieved. Additional to the good gas separation properties, polyamides membrane also show good mechanical, chemical and thermal stability. Measurement of the gas transport properties of all the synthesized polymers and to draw a structure property co-relationship is under progress.

- Development of copper chromite catalyst as a substitute to noble metals for purification of vehicular exhaust is under progress at, BHU, Varanasi. Highly active copper chromite catalyst prepared by

calcinations of the precipitated basic copper ammonium chromite catalyst ($CuOHNH_4CrO_4$) was developed as substitute to noble metals for purification of vehicular exhaust. A compact and versatile laboratory tubular reactor has been designed and fabricated. An experimental set-up for performance evaluation of the prepared catalysts has been installed. Prepared precursor and catalysts have been characterized by Thermal Analysis (TGA, DTA), Particle Size Analysis, BET Surface Area measurements, X-ray diffraction and TPR.

- Synthesis of the high strength and ductile AA2219 alloy and AA 6061 alloys of Cu-5 wt. % Zn and Cu-5 wt. % Al, through plastic deformation by cryo-rolling route (at cryogenic temperatures (77K) were successful developed at IIT, Chennai establishing that high energy ball milling/mechanical alloying leads to much finer grain sizes when compared to other severe plastic deformation (SPD) processes. The mechanical properties of ultra fine grained (UFG) alloys indicated an ideal plastic behaviour with negligible work hardening. The AA2219 and AA6061 alloys are used for high strength aerospace structural applications. The nanostructure alloys produced in the present study showed a compressive strength of 800 MPa. Though the compressive ductility was low (1%) in this condition, compression ductility was improved annealing following consolidation. The alloys therefore could be used in applications where compressive loading is predominant.

- Development of nanocrystalline lead free ferroelectric and dielectric materials of Barium Zirconium Titanate (BZT) and Barium Strontium Titanate (BST) using different preparation techniques viz., mixed oxide route, high energy ball milling route and co-precipitation were successfully made at IIT,Channai. BST powders were characterized for phase formation, stoichiometry, compaction and sintering behaviors Microstructure and functional properties of the ceramics prepared from all routes were evaluated and compared. It was noted that BZT and BST powders prepared through ball milling require relatively low temperature treatment (~900^0 C) and (~1200^0 C) respectively for shorter duration (2 hour) for phase formation as compared to other solid state routes. The particular size of these powders prepared through ball milling routes after heat treatment was smaller than that by solid state routes. Maximum density achieved in solid state route was 94% as against 99% in ball milling route and 97% in co- precipitation route. Dielectric constant has been doubled (~15000) in the present ceramics prepared from ball milling and co- precipitation compared to mixed oxide route (~7000^0 C). The dielectric loss was more or less similar in both ball milling and co-precipitation routes.

- Development of New Novel bio-materials of Titanium Alloys with improved Tribological properties were successfully made at Vellore Inst. of Technology, Vellore. These bio-materials are ideal bio-material of Ti-13Nb-13Zr for implant application especially for joint replacement.The surface modifications on the newly developed alloys were carried out by laser nitriding, nano TiO_2 and HAP coating by plasma spraying technique. Corrosion and wear behaviour study of coated samples were evaluated using Poteniostat and Reciprocating tester respectively. Enhance wear and corrosion resistance was observed for the bilayered coating of ZrO_2 coating and Al_2O_3-$13TiO_2$. Scratch test was performed using a commercial micro scratch tester (DUCOM), India to evaluate the adhesion strength of the coatings. Thus these coatings are expected to enhance the service period of the implants.

- A new technique of surface engineering called Plasma Assisted Implantation and Deposition (PAID) was successfully developed at IIT, Kharagpur by modifying an existing Plasma immersion ion

implantation (PIII). Plasma nitriding of annealed set up 52100 steel were carried out which leads to significant improvement in hardness and wear resistance of the steel, particularly at 560^0C for 3-5 h. Interstitial free (IF) steel is a low carbon, low alloy ferritic steel widely used for various structural parts (mainly body frame) of modern day automobiles. The main novelty of this grade of steel lies in its high formability due to its very low solute or interstitial content. Sputter deposition of Ti for 2 h followed by plasma nitriding (at 450^0C for I-5 h) yields a mixed nitride layer that shows enhanced hardness, wear and improvement in corrosion resistance. Thus the objective to produce nanocrystalline coating has been successfully developed.

The Plasma Assisted Implantation and Deposition (PAID) set up at the IIT-Kharagpur.

The instrument has a capacity of implantation energy up to 20 keV and ion density up to 10^{16} ions/m^3. The sample can be heated to 500^0C. Plasma is created by a RF source (13.5 MHz) with operating pressure between 10^{-4} - 10^{-3} torr.

- Studies on Micromechanical Characterization of Hydroxyapatite Coating for Metallic Implants were carried out at CGCRI, Calcutta. Phase pure, free-flowing Hydroxyapatite (HAp) powder was prepared from the conventional chemical co-precipitation route. The bio-compatibility tests and toxicity tests were conducted on this HAp powder at the Bengal Immunity Research Centre, Kolkata. The results showed that these Hap Powders were non-toxic and bio-compatible. The micro-sprayed HAp Coatings on SS316 L, Ti-6Al-4V substrates were developed. The coating exhibited the moderately high bonding strength of about 25 MPa. Nanoindentation technique was employed to estimate the residual stress of the coating. Furthermore, Soluble Body Fluids (SBF) dissolution study for 1-14 days confirms the deposition of HAP phase and the in vivo experiment was found to be suitable for osteoconduction and may prove its promising role in fracture repair of veterinary and human cases too. Finally, in-vivo animal trial by intramedullary pinning (method of fixation of defect bone) utp 60 days produces a satisfactory result of tissue response from radiological examination, histological study and fluorochormome labeling study. Bone defect healing was comparatively more

due to "bone bonding" and ossointegration in HAP coated pin followed by uncoated pins which may prove its promising role in fracture repair in both human and animals

- Successfully developed a trivalent Chromium plating bath in place of hexavalent chromium bath at CERI, Karaikudi. This bath is less polluting and eco-friendly and also uses less quantity of chromium. Successfully deposited chromium with a thickness 26 microns from four different Trivalent bath namely chromium-glycine bath, chromium-urea formate bath, Chromium (III)-Dimethyl formamide-thiocyanide bath & Chromium (III)-Dimethyl formamide bath with different compositions. The variation of Pulse parameters on the thickness, Hardness and corrosion resistance were studied in detailed. Wear resistance of Cr coating from Cr(III) and Cr(VI) electrolytes were calculated for 1 kg load and 100 cycles and the weight loss is 0.0017mg and 0.00024mg respectively. Since very low wear loss was obtained for Cr deposit from Cr (III) electrolyte, these Cr can be used for functional application.

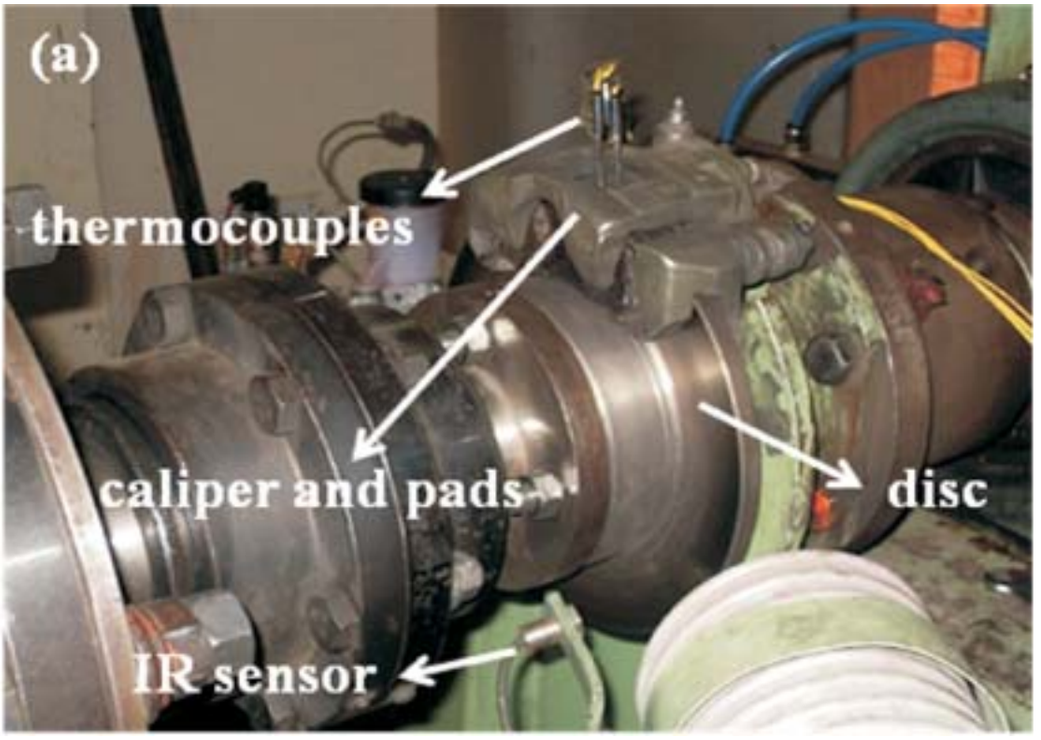
- Studies on Microstructural and Textural Evolution during Recrystalli- zation of Cold Rolled Al-Mn-Mg alloys were completed at NML, Jamshedpur. The material used in the present investigation was continuously cast AA3004 aluminium alloy. The alloy had 1% Mn and 1% Mg apart from Fe, Cu and si within 0.1%. The as-received material was a commercially produced CC3004 hot band with a thickness of 4.5mm. This hot band was given two different treatments to generate different precipitation states. The treatments are mentioned in the followings: i. Sample A:Solution annealing at 550^0C and annealed ii. Sample B:Solution annealing at 550^0C and air quenched. The two hot bands were then cold rolled to different reductions ranging from 20%, 40%, 60% and 90%. After rolling samples of 90% cold rolled samples were annealed at various temperatures ranging from 250^0C to 400^0C for various lengths of time. Texture measurements were performed at the mid-thickness of the cold rolled sheets. Hardness measurements were carried out in Leica Microhardness tester with 25 gm load. Good formability of Al-Mn-Mg alloys through control of texture evolution and control of grain size during recrystalizations. These Al-alloys can be the best candidate material for automotive industry container-making industry as well as packaging industry project completed successfully.

- Studies on simulation of the growth of heteroepitaxial semiconductor thin films using finite element method is under progress at IIT, Kanpur. The primary objective of the proposal is to generate of a finite element model in commercially available software like ABAQUS for a growing heteroepitaxial semiconductor film. First, a 2D model was generated followed by a 3D model. FEM simulations of a growing hetero-epitaxial film of GeSi on a Si substrate were achieved. Stress free strain has been used to model a growing hetero-epitaxial film using FEM and growing film was modeled by increasing the region of the domain where the strains were imposed. The simulations developed can help in the design of semiconductor devices based on epitaxial layer systems. (e.g. heterobiopolar transistors, modulation-doped field effect transistors (MODFETs), magnetic recording media, solar cells, laser structures, infrared detection devices etc.

- An advanced laboratory was set up to study the tribological properties of friction materials at Industrial Tribological Machine Dynamics and Maintenance Engineering Centre (ITMMEC), IIT, Delhi. Unique facility of Inertia Dynamometer for brake performance evaluation of Light Commercial Vehicles (LCVs) & Heavy Commercial Vehicles (HCVs) were developed in this project. Such facility is available only with very big Industries and not with any research group in India. Even abroad, such facilities are rare with a research groups in universities. Other facility of thermal conductivity analyser was also procured which is useful for all types of materials including friction materials and not available with Indian

Industries. Very few academic/research Institutes have this facility. Using this facilities developed few new formulation of non-asbestos, low metallic fibre reinforced organic friction materials (NALMFROFM) for brake pads (for cars and buses) and brake blocks (for trucks).

Brake Inertia Dyamometer (braking end)



Fixed car braking assembly on Dynamometer

SERC SCHOOL

- One SERC School to build awareness and competence in the country in the area of mineral biotechnology was conducted from 14-19 December 2009 at IISc., Bangalore**.** The School was focused on two aspects: (i) Bioleaching (ii) Bioremediation. In order to facilitate higher participation, UGC-Networking Centre at the Department of Materials Engineering of Indian Institute of Science, Bangalore extended co-sponsorship for the School. Total 32 participants mainly young faculty, young scientists and doctoral research scholars from all over the country were benefited from this School

Mechanical ,Civil Engineering and Robotics

The PAC on Mechanical & Civil Engineering, Robotics & Manufacturing supported 49 projects out of a total of 110 projects received by it during the year. It had 4 meetings during the year during which it reviewed 54 ongoing/completed projects. Some of the highlights of the projects that were supported under the PAC are given below:

➢ **Some investigations on cracking characteristics of fine-grained soils: (Civil-IITB)**

Through this proposal the team has investigated cracking characteristics of fine-grained soils and their tensile strength. The research will help in development of a generalized model for estimating cracking characteristics.

➢ **Development of models for managing water quality in drinking water reservoirs (Civil-IIT Chennai).**

The output of this project is helpful for planning the catchment and environmental projects to protect such reservoirs from contamination and plan operation of rural water supply schemes.

➢ **Design and development of miniature robot for biopsy and vivo-surgery (Robotics-IIT Roorkee)**

Project aims to develop mathematical modeling along with simulation of in vivo robot system. Based on geometric, kinematic and dynamic requirements of end-effector a miniature robot will be designed and developed to implement biopsy of stomach model.

➢ **Experimental investigations of a bio-oil in a DI diesel engine (Interdisciplinary) NIT-Rourkela**

This research work aims to convert the wooden waste available in timber, plywood and waste residues from pulp industries into bio-oil by pyrolysis process and use the pyrolysis oil as an alternate fuel for diesel engines. The combustion, emission and performance of a diesel engine will be analyzed by using the bio-oil by employing various techniques. .

➢ **3D Nanofabrication using Electric Discharge Machining (Mechanical) IITK**

The project aims to develop a Vacuum micro-EDM set-up with nano resolution and NE (nano electrodes) to study plasma characteristics like electron density and plasma temperature with varying process parameters like input voltage, current, duty cycle during EDM process at nano scale and

fabrication of 3D nanostructures. Proposed study has potential application in aerospace and automobile sector for bringing in qualitative improvement in nano manufacturing through EDM.

The third SERC School in the area of Micro-fabrication and Micro-machining was organized at IIT Kanpur during this period. About 35 participants mostly from academic institutions and national lab participated in this school and updated their knowledge in the area of micro machining through lectures given by experts not only from the country but from abroad. The fourth SERC School is being planned at Jadavpur University in April, 2010.

A workshop on "manufacturing engineering" was held in CMTI Bangalore in which 75 professionals from academic institutions and industries participated.

The review of a major proposal in manufacturing engineering supported by PAC at IIT-Chennai was undertaken by an Expert Committee. The installation of the 5 axis machine has just been completed and the team has been asked to conduct studies for manufacture of parts with complex geometries. The Department is also in the process of supporting a major initiative for enhancing the manufacturing capabilities by setting up a Centre at IIT Chennai and IISC Bangalore.

In the area of Combustion Research the Department has initiated process for evolving SERC School. It is also processing 2 major proposals for setting up Combustion Research Centres with human resources development as one of its major objectives.

MATHEMATICAL SCIENCES

The Mathematical Science Programme promotes research in Mathematics, Statistics, Operations Research and Theoretical Computer Science, including specialized manpower training for talented college students in remote areas and research students/ young faculty members from college/universities/research Institutions, Interaction meets between mathematicians and prospective users and other awareness programmes. The highlights of the progress/achievements are as follow:

❖ **Support to Research in mathematical Sciences:**

- 50 new research projects were supported in the areas including Algebra, Number Theory, Topology, Differential geometry, Graph theory, Fluid Mechanics, Differential Equations, Solutions to the boundary value problems, Coding Theory, Combinatorial Optimization, Celestial Mechanics, , Mathematical Modeling, Functional Analysis, Stochastic Process Modeling, , Data Mining , etc.
- Support to 100 ongoing projects was continued.
- As an outcome more than 100 research papers have been published in the Journals of National and International repute.
- 3 group monitoring workshops were held to review the progress of the ongoing projects.

❖ **Support to the following centres/ Core Group Research facilities were continued.**

- **Centre for Mathematical Science at Pala in Kerala:** The focus of the research remained in the areas of fractional calculus, special functions, statistical distribution theory, geometrical probability, stochastic Processes, discrete mathematics and astrophysics. 14 research scholars

are being trained in the above areas. More than 25 research papers have been published in the journals of National and International repute during the year. Two research level books have also been published.

- **Centre for Advance Research in Discrete Mathematics at Kalasalingam University, Krishnankoil, Tamilnadu:** The focus of the research remained in the area of discrete mathematics. 10 research scholars are being trained in this area. More than 25 research papers have been published in the journals of National and International repute during the year.

  The centre with the University of Newcastle, Australia and CR Rao Advanced Institute of Mathematics, Statistics and Computer Science (AIMSCS), Hyderabad organized Fifth International Workshop on Graph Labelings (IWOGL 2009). About 120 participants including 10 experts from USA, UK, Australia, Czech Republic and Slovakia attended the workshop. The centre also organized an Instructional Workshop on Statistical Modeling and Simulation in two batches for the research scholars and young faculty members.

- **Centre for Interdisciplinary research in Mathematical Sciences at Banaras Hindu University, Varanasi:** The focus of the research remained in the areas of Bayesian Statistics, Discrete Mathematics, Mathematical Modeling, Numerical Computation, Stochastic Modeling, Wavelets and Functional Analysis. 12 research scholars are being trained in the above areas. More than 20 research papers have been published in the journals of National and International repute during the year.

- **Centre for Mathematical Biology at Indian Institute of Bangalore:** The focus of the research remained in areas of Mathematical and Computational Neurosciences, Mathematical Genomics and Proteomics and Mechanics of Cells and Tissues. 6 research scholars are being trained in the above areas. More than 10 research papers have been published in the journals of National and International repute during the year.

- **Centre for Mathematical Sciences at Banasthali Vidyapeeth, Rajasthan:** The focus of the research remained in area of Discrete Mathematics and Statistical & Mathematical modeling. 4 research scholars are being trained in the above areas. More than 20 research papers have been published during the year.

- **Centre for Mathematical Sciences at CR Rao Advanced Institute of Mathematics, Statistics and Computer science, Hyderabad:** The focus of research remained in the areas of discrete mathematics, graph and digraph theory with applications to social, biological and physical and behavioral sciences, bio-informatics, and dynamical systems, cryptography, combinatorics, bayesian analysis, design of experiments, biometrics, orthogonal arrays, time series and econometric models with applications to national developments, theoretical computer science, signal processing, analysis of algorithms and complexity, financial mathematics and Modernization of the Indian Statistical System etc. 12 research scholars are being trained in the above areas. More than 26 research papers have been published in the journals of National and International repute during the year.

  During the year the centre organized an International Conference on "Frontiers of Interface between Statistics and Sciences". The conference was attended by about 200 research workers from India and abroad including Prof. C.R.Rao (FRS), and Abel Laureate Dr. SRS Vardhan.

Workshop on Image and Speech processing and Workshop on Statistical and Mathematical Methods in Biology have also been organized by the centre.

- **National Mathematical Sciences Initiative-**The support for National Mathematical Sciences Initiative was continued at Indian Institute of Science, Bangalore to organize compact lectures/ workshops/seminar etc.

❖ **Programme for Manpower development:** Following Training programmes/Workshops/ SERC School were held during the year**:**

- **SERC School -**A SERC school on "Matrix valuable calculus and statistical distribution theory and applications in data analysis, model building and astrophysics problems" was held at Centre for Mathematical Sciences, Pala. 40 participants from all over the country got benefitted by attending the SERC School.

- **National Meet of Research Scholars-**National Meet of Research Scholars in mathematical Sciences (NMRSMS-09**)** was organized at I I T, Roorkee to train the research students about research methodologies and to improve the presentation skill etc. 45 participants from all over the country attended the meet.

❖ **Training Programme/ Workshops/ Colloquium etc**

25 Training Programmes/Workshops/Colloquium etc were organized at various college/university/ institution spread allover the country on the following topics:

Mathematical models for Performance Oriented Heuristic Techniques and its Applications in Industry, Cryptology, Optimization Techniques and Their Applications, Advance Numerical Techniques and Applications, Advances in Mathematical Algorithms and Data Analyses, Mathematical Modelling and Related Optimization Techniques , Mathematical Models for Bio-fluid Flows and Applications, Application of Mathematical Methods in Physical Problems, Fractional calculus and Statistical Distributions, Bayesian Statistics: Theory and Applications, Dynamical Systems, Graph Theory, Algebra and Algebraic Number Theory, History of Mathematical Sciences, Perspectives in Mathematics, Statistical and Mathematical Methods in Biology, Modern Trends in Celestial Mechanics and Astronomy, etc .

The said activities were organized to train our research students/ young faculty and to keep them abreast with the latest developments in mathematical sciences and to take benefit of large galaxy of mathematicians in the forthcoming International Congress of Mathematicians (ICM) to be held in India at Hyderabad during 19 -27 August, 2010.

❖ Support was provided to Ramanujan Galary at Periyar Tamilnadu Science & Technology for upgrading it on the life and work of genius Srinivasa Ramanujan to inculcate the spirit of math among the children and researchers**.**

❖ Publication of two volumes of Ramanujan Mathematical Lecture note series in Mathematical Sciences (RMS-LNSM) have been supported in the areas of Operator theory and Geometric Group Theory.

ATMOSPHERIC SCIENCES

Studies related to the physical, chemical and dynamical aspects of the atmosphere (lower, middle and upper atmosphere) including the monsoons, coupled land-ocean-atmospheric system, geosphere-biosphere

interactions and development of technology are being supported under Atmospheric Science program. During the period under report organized three meetings of the 'Program Advisory Committee on Atmospheric Sciences'. A group monitoring workshop was organized in which 15 completed projects were evaluated and monitored the progress of 39 ongoing projects. A national discussion meeting on 'Atmospheric Sciences' was organized to revise and update the thrust areas for extra mural research support. The salient achievements under the above program are as follows:

Space Weather Physics and Dynamics

Investigations on the structure and dynamics of ionospheric irregularities through radio beacon scintillations, very low frequency wave propagation and exploration of Magnetospheric plasma, variations of the total electron content and ionospheric perturbations due to earthquakes, characteristics of low latitude magnetic pulsations over two Solar cycles, nonlinear coherent wave structures in magnetosphere and ionospheric plasmas, non-linear wave models, remote sensing of low latitude ionosphere and magnetosphere using whistler technique and application of Global positioning system for monitoring the Earth's atmosphere, and establishment of 'Stratosphere-Troposphere (ST) Radar facility at Nainital' are in progress. Also, study of nonlinear processes in Sun Earth connection and establishment of three more ST Radars in India has been initiated.

Atmospheric Dynamics and Modeling

A Weather Research Forecast (WRF) model with 30 km resolution and a ROCM (Regional Ocean Circulation Model) was chosen to develop an Indian regional coupled climate modeling strategy. Developed a coupler and achieved daily coupling and transfer of fluxes between ocean surface and atmosphere. The results indicated the sea surface temperatures (TMI-SSTs) are well correlated and the cold bias has been rectified. There is need for more studies to diagnose the problems associated with this modeling strategy. Study of the outputs of 25 coupled climate models (used for IPCC AR4) indicated bias in all the models and finally evaluated 10 select climate models output parameters over south Asia in particular the ENSO monsoon and Indian Ocean Dipole relationships. The projections at the end of the 21 Century showed that although the monsoon circulation is weaken, there is significant increase in mean monsoon precipitation over India under the climate change experiments. Studies of the atmospheric energetics during the onset phase and active phase of the monsoon season and inter comparison of model simulations with different resolutions, predictability studies of the atmosphere using error growth studies on low dimension mesoscale and global models are in progress.

Initiated studies on 'Energetics of zonal waves and intra-seasonal variability of Indian monsoon', 'Sensitivity of sea surface temperature over Indian Ocean and land cover/ vegetation classes on Indian summer monsoon precipitation', 'Numerical simulation of western disturbance and associated extreme weather using a mesoscale model', and 'Establishment of a coupled climate and carbon cycle modeling activity and investigation of the effects of CO_2 fertilization'.

Aerosols and atmosphere Interactions

Completed the development of handheld Sunphotometer using filter photo detectors as sensors to monitor aerosol optical thickness, columnar water vapor and ozone concentration in the atmosphere and validation is in progress. Regular sampling is under progress for selected houses, indoors and outdoors, for different particle size, concentrations of fine and coarse particulate matter and meteorological conditions at Agra region, measurement of organic and black carbon and chemical constituents of ambient aerosols at a

suburban site of the Indo-Gangetic plain; study the impact of aerosols and gaseous pollutants in ambient air on physiological parameters of human health due to agricultural crop residue burning at Patiala; sampling and analysis techniques for bio-aerosol standardization and field evaluation for airborne entotoxine are in progress.

Initiated studies on 'role of Polycyclic aromatic hydrocarbons (PAH), Volatile organic compounds (VOC) and Ammonia in aqueous phase atmospheric autoxidation of Sulfur dioxide', 'Ambient air pollution and its sources in the background sites of different hill spots in the northwestern Himalaya, Himachal Pradesh', 'Characterization, toxicity and health risk assessment of polycyclic aromatic hydrocarbons (PAH) in particulate matter and emissions from different combustion fuels', 'Spatial and temporal dynamics of urban heat island in Delhi and its implication for the air quality of Delhi', and 'Study of distribution and sources of ambient Ammonia over northwest India'

Ocean-atmosphere interactions

Studies on Sea level variations over the Bay of Bengal, with respect to occurrence of different combinations of ENSO and Indian Ocean Dipole (IOD), using satellite altimeter data showed significant characteristic features due to the combined effect of ENSO and IOD events. In some cases the occurrence of one event is overriding the characteristic features of other events. Rapid ecosystem response to the episodic events (ex. Rainfall) on the biogeochemistry of the coastal waters off Visakhapatnam, significant decrease in dissolved oxygen levels due to enhanced primary production triggered by land driven material exported by heavy rainfall were observed. Further, observed persistent existence of cold core eddy with nutrients and chlorophyll-a concentration off Visakhapatnam coast.

Agrometeorology

Assessment of present carbon stocks in the natural forest ecosystems of the Kodugu district of Karnataka and validation of pathogen environment interaction models of Karnal bunt disease at Punjab have been completed. Field experiments to understand the crop-weather interactions in selected medicinal and aromatic plants grown in Himachal Pradesh, Studies on carbon sequestration potential of reduced tillage system under rainfed conditions, studies on the climate impacts of sugarcane growth and yield in eastern Uttar Pradesh are in progress. Studies on the 'Integration of crop growth and yield response of cotton to multiple environmental stresses, soil and genotypes in space and time by dynamic simulation' were initiated.

Greenhouse Gas Emissions from Agro-ecosystems

Ambient ozone levels at Delhi affected the crop productivity and growth. Charcoal filteration of ozone from ambient air has a positive impact on all the growth and yield parameters in rice and maize. There was about 27% decrease in yield of maize under elevated ozone concentrations. Whereas elevated carbon dioxide along with elevated ozone was able to offset some of the negative impact of elevated ozone alone. Field studies were carried out at two different locations in Orissa to estimate the N_20 emission from traditional and non-traditional pulses. The results suggest emission of N_20 depends on edaphic and atmospheric parameters and there was no difference among the cultivars under study. Completed the field experiments to quantify the N_20 emission from rice and wheat crops grown in the Tezpur region of northeast India. There exist wide fluctuations in N_20 emission rates in different varieties of rice and wheat in relation to soil and plant factors and ecosystem. Measurements of ozone concentration at Pune showed that long-range transport of background ozone and precursor pollutants also contribute to the exceeding of critical

levels for protection of vegetation. Surface ozone is much above critical levels and is a concern for human health and agricultural productivity. A Chemistry transport model forced with dynamical fields study indicates that the Indo-Gangetic plain region is highly vulnerable to human induced pollutant emissions and source regions of ozone precursors within which these tracers remain confined and reinforce photochemical production of ozone. Measurements in the vicinity of sugar factory indicate pollution level during nighttime are higher than the daytime.

Continental Tropical Convergence Zone

Special emphasis was given under Indian Climate Research Program to evolve and implement multi-agency, multi-disciplinary coordinated field experimental campaigns to investigate the land-ocean-atmosphere interactions and their role in monsoon variability. Science plan of 'Continental Tropical Convergence Zone (CTCZ)' was published. CTCZ objectives will address physical processes taking place on synoptic, meso, cloud and cloud microphysical scales and their interactions. Monsoon involves land-ocean-biosphere-atmosphere interactions and their feedbacks, and these issues are given importance in CTCZ. The direct and indirect effects of aerosols on monsoon variability on different time scales are among the objectives of this study. Special efforts be made to elucidate the nature of the cloud systems over land and measure critical components of water and heat balance in selected basins/watersheds in the monsoon zone to understand the impact of land surface processes and gain insight into genesis of cloud systems and their propagations over land and ocean. CTCZ is a multi-year program involving special field experiments over land and ocean, in situ cloud observations with instrumented aircraft, analysis of existing data from conventional platforms as well as satellites, buoys, ARGO floats, and theoretical/ numerical model studies with the active participation from all concerned institutions in India. A pilot phase of CTCZ was implemented during 01 July to 31 August 2009 utilizing most of the existing observational weather monitoring networks including Radars, aerosols, agro meteorological stations, met-ocean data buoys, Argo floats and drifters, two ships (ORV Sagar Kanya and OTV Sagar Nidhi), two aircrafts with state-of-the art instrumentation, additional radiosonde systems at Kharagpur and over northern Bay of Bengal, three micrometeorological towers (Kharagpur, Ranchi, and Anand), stand-alone atmospheric observing systems (ex. Micropulse Lidars, Sodar, Desdrometers, etc) at few locations north of 18^{o}N, up to foothills of Himalayas. Efforts are underway to undertake main mega field experiments during 2010 and 2011 periods mustering all possible infrastructure and expertise to understand the monsoon dynamics over the Indian region.

Initiated studies on 'Oceanographic observations in the northern Bay of Bengal deep convection during CTCZ', 'Oceanographic observations in the southern Bay of Bengal cold pool during CTCZ campaigns', 'Oceanographic observational component during CTCZ', 'Surface energy budget and boundary layer structure over the Bay: An observational study during CTCZ', 'CTCZ pilot phase 2009: XCTD observations in the northern Bay of Bengal', and 'Interactions between the atmospheric boundary layer and deep convection over the CTCZ domain'.

Human Resource Development activities:

Recognizing the need for highly skilled human resources in atmospheric sciences to meet the enhanced interest in the discipline organized the following:

1. SERC School on 'Atmospheric effects and local area augmentation systems'
2. SERC School on 'Aviation weather hazards: Concepts and modeling'

3. SERC School on 'Atmospheric Chemistry and Air Pollution'

4. Training program on 'Advances in Plant-atmospheric interactions'

5. Training program on 'Electro dynamical coupling of atmospheric regions'

6. Training program on 'Application of Geomatics in Urban transportation planning and management'

7. Advanced training program on 'Use of Geomatics in disaster mitigation and management'

8. Advanced training program on 'Setting up an industry: Its planning and management in the context of its impact on local earth system parameters'.

9. Advanced Summer training school on 'Application of Remote Sensing and GIS tools for coastal and ocean resource mapping, monitoring and management'.

EARTH SCIENCES

The Programme Advisory Committee on Earth Sciences (PAC-ES) has the basic mandate of evolving and supporting R&D projects in emerging areas of research in Earth Sciences. A number of coordinated research programmes in topics and disciplines which are particularly relevant to the Indian context and require a fillip were discussed during different meetings of the PAC. The PAC also discussed the need to update the Vision document on Earth Sciences. The PAC also addressed research initiatives pertinent to the national requirements, creation of research infrastructure; develop manpower; organizing of Brain Storming session and Workshops on themes of topical interest such as Ground Water and Palaeoclimate Study which may eventually lead to initiation of co-ordinated research programme.

Following is the gist of the highlights of some of the projects that are supported under the programme:

Completed Projects

Organic Walled Microfossil Characterisation of Palaeozoic Lithounits of Grahwal Tethyan Himalaya-High resolution Biostratigraphy

Under the project, a detailed study along the Sumna-Rimkhim section comprising of Shiala formation has yielded moderately diversified and well preserved chitinozoan assemblage along with microflora such as algae and acritarchs which is a new finding from this part of the Globe. Two species such as *Belonechitina Capitata and B. micracantha* have been reported in this section.

Modeling for Changes of Coalbed Methane Reservoir Permeability due to Stress

Well Log analysis has been carried out to evaluate resistivity and density log data of about seven wells distributed over 3.5 sq Km area of Raniganj and Rangamati coalfield area. The vertical stress measurement carried out in theses area indicate that the stress magnitude decrease with coal seams compared to the stress gradient at roof and floor of the same seams. Permeability studies have been carried out to correlate these values with the horizontal stress.

Identification of Recharge Zones through hydrogeological approach in Varha river basin, Andhra Pradesh

A ground water recharge zone map of the Varaha river basin has been prepared by integration of thematic layers of climate, rainfall, slope, soil, drainage density. geomorphological features etc. in a GIS

platform. Different ground water recharge zones were classified based on the above information and field verification. Based on the environmental hydrogeological conditions, various groundwater recharge structures were recommended.

Platinum Group elements and associated sulphide mineralization at Boula-Nausahi Igneous Complex, Orissa

The platinum group of elements(PGE) and their associated base metal sulphide minerals were investigated in the breccia zone of the Boula-Nausahi Igneous Complex, Orissa. It has been reported that the ferrian chromite and arsenopyrite are the major host of Platinum Group elements. After a detailed geochemical study, it has been concluded that the ferrian chromite is the principal host of PGE minerals and can be explored and exploited for PGE recovery.

Ongoing Projects

Reconstruction of monsoonal rainfall from the late Quaternary Himalayan foreland sediments by Stable Isotope tracers: implications to climate forcing on vegetation and river response

The oxygen and carbon isotopic ratio of petrographically constrained soil carbonate (insignificant post-diagenetic alteration) and carbon isotope ratio of organic matter (SOM) associated with the Kalpi and Firozpur core have been measured. The co-variation of ´^{13}C and dð^{18}O values of soil carbonates show that periods corresponding to enhanced monsoon are represented by increase in C_3 plants. The monsoon-vegetation-atmospheric CO_2 relationship for the time period 84 to 18 ka indicate that abundance of C_4 was driven by the decrease in monsoonal rainfall, and atmospheric CO_2 had negligible effect on the relative abundances of C_3-C_4

Studies on exsolved phase mineralogy and chemical finger printing of East Coast Placer ilmenites to establish Genetic affinities and to evolve economic implications.

Based on the geochemical studies, it has been reported that there is an occurrence of Zinc bearing Ilmenite or Zincian Ilmenite in the placer deposits of east coast. The samples of other two deposits are being processed for EPMA analysis and this work been completed.

Nature of Proterozoic Magmatism: A case study of the Dunite: Pyroxenite – Syenite Carbonatite Complex of Pakkanadu, Salem District, Tamil Nadu, Indian

It has been reported that veins and lenses of carbonatite together with dunite and pyroxenite has been noticed in the southern part of the Pakkanadu complex near Kudakkal village. Discovery of carbonatite with pyroxenite and dunite at Kudakkal indicates the possibility of the continuation of the carbonatites from Panangattur.

Water Balance Studies of the Forested Watersheds Western Ghats, India

The PI reported that soil moisture measurements were taken at three land covers at different soil depths and slopes to arrive at soil moisture fluxes. Both temporal and spatial variations of soil moisture profile showed that there is temporal variability. Degraded watersheds responded relatively steeper and peaks on soil moisture rapidly whereas acacia and forest responded slowly and soil moisture built up was slower. Vertical profile of soil moisture profile indicated a high value in the bottom of the watershed could be due to contribution of flow from bedrock to the soil.

Mesozoic Gondwana Vertebrate form Madhya Pradesh, India: A integrated study on Paleobiology

Nine new vertebrate yielding sites in the Upper Triassic of Tiki Formation representing a mass burial event have been reported and a large number of veretebrate fossils belonging to various groups of reptiles have been recovered. Another important finding of this project is the discovery of dinosaur remains for the first time from the Bagra Formation of Central India.

INTENSIFICATION OF RESEARCH IN HIGH PRIORITY AREAS (IRHPA)

IRHPA is a complementary programme to the SERC programme with activities consisting of setting up of units/ core groups around an eminent scientist and major National Research facilities to nucleate research activities in these areas. The scheme has contributed to augment general R&D capabilities at academic institutions and national laboratories in the areas of Palaeomagnetism, Low Temperature and High Magnetic Field, Crystal Structure, Robotics, Laser Spectroscopy, Structural Biology, Surface Science & Technology, Computational Fluid Dynamics, Technical Acoustics, Geocentrifuge for Engineering applications etc.

- A facility on " Spatially Resolved Magnetic Resonance" has been established at IIT, Chennai. Spatially resolved MR addresses heterogeneous multi-component systems, and enable measurement of molecular distribution and transport within the object and retrieve structural information. Several experiments were performed. Some important ones are: (i) measurements of self-diffusion coefficients in a variety of systems including PEM's, Surfactant micelles as well as micelles with small reactant molecules loaded ; zeolites with small molecules loaded. (ii) I*n vitro* investigation of drug molecule arrival at specified voxels in a medium mimicing physiological conditions (i.e. drug dissolution kinetics) by volume localized PRESS spectrometry as a prelude to future *in vivo* investigation and (iii) process monitoring on natural and artificial ripening of post-harvest fruits.

- Under Physical Science one project has been sanctioned during this period. This project was proposed to investigate various issues in the emerging area of quantum information theory and quantum optics, viz.

  i) Protocols for storage, transfer and distribution of quantum information

  ii) Quantum optical implementation of information exchange

  iii) Specific applications of quantum information in high energy physics, gravitation and cosmology

  iv) Experimental realization of novel quantum phenomena, and their foundational perspective

Establishment of Electron Probe Micro-Analyser (EPMA) National Facility at IIT, Kharagpur

Electron Probe Micro Analyzer has been installed during mid- October 2008 and after necessary calibration and standardization and the instrument was opened to general public for use in December 2008. The EPMA installed at IIT Kharagpur has unique distinction as the filament is tipped with Lanthanum Hexaborate. The instruments have capabilities including WDS Scan, SE-BSE imaging, X-ray mapping, Quantitative analysis for major and trace concentrations and its application in chemical dating. Around 2000 samples from Industries and academic institutions have been analyzed using this Instrument. The Scanning Electron Microscope with Energy Dispersive Spectrometry (SEM-EDS) has been installed at IIT, Kharagpur. The range of capabilities of the instrument have been fully utilized by the different users

from Mechanical engineering, Chemistry, Rubber Technology, Chemical engineering, Cryogenics, Metallurgy and Physics.

Science of Shallow Sub-surface (SSS)

- Developmental activities cause global warming, air and water pollution, health hazards and degradation of natural environment, unfavourable for the existence of living beings. Motivated by a mix of scientific, environmental, economic, health and safety concerns, a programme on Science of Shallow Sub-surface(SSS) was launched during 2005 to study and understand the shallow subsurface(upto a depth of 100 meters), in an integrated manner in which and with which we build and live. A significant progress has been made under the programme . Multidisciplinary studies on different bio-geo-chemical properties have been carried out in different corridors such as Ganga, Cauvery, Baroda, Narmada, Kachh, North Brahamputra and South Brahmaputra.
- Integration of outcrop data, drill cores, geophysical data, clay mineralogy, soil miocromorphology , magnetic mineralogy– a multi-proxy approach for understanding stratigraphic response to source area variability and climate change of Ganga Corridor have been carried out.
- A full-scale core archive and analysis facility at IIT Kanpur is fully operational and available for the scientific Community.
- In order to evaluate the ongoing physical, geochemical and biological processes in the subsurface and their possible effects on the hydrology, agricultural productivity and climate of the Cauvery delta region, drilling at 9 locations have been completed, the lithologs of the samples have been prepared and the detail geochemical works are under progress.
- Detail studies have been carried out to understand the geological, geochemical, and biological aspects of the shallow subsurface sedimentary records of the Gujarat Corridor.

- About 15 multidisciplinary projects have been supported to various Institutes of North East India under the programme to study the sub-surface of Brahmaputra plain. The projects are at various stages of implementation.

500MHz NMR Microimaging Facility set up at IIT Chennai

OPPORTUNITIES FOR YOUNG SCIENTISTS

Realizing the importance of development of Scientific Manpower for taking up research in challenging areas of S&T, the Department in its 11th Plan has decided to focus upon the schemes that are facilitate encouraging, supporting and nurturing Science students and Young Scientists in a coordinated manner.

Fast Track Scheme for Young Scientists

FAST track scheme for Young Scientists has evolved as one of the prestigious and popular programmes at the national level. The scheme encourages Young Scientists to take up R&D in innovative and challenging areas that they might have identified during the course of their research work. This has resulted in training of scientific manpower required to meet the challenges in the future. Screening and monitoring mechanism was strengthened further for getting "quality" output from these scientists, thus making them candidates for receiving prestigious awards in national and international forums. Special efforts were made to identify and encourage active young scientists working in institutions in remote areas.

During the current year, sanctions have been issued for 355 new projects costing a total of about Rs. 5428.8 lakhs and 360 ongoing projects in various disciplines. Several projects in frontier areas were supported. This support has helped young researchers to undertake independent research.

The following are some of the interesting results obtained from the projects:

- Successful insertion of various POMs in the interlayer of LDH through rehydration of calcined LDH (450 °C) under N_2 atmosphere has been achieved. It is observed that introduction of POM in LDH led to increase the photocatalytic activity.

- It is established that hydrophobic clustering is not a strong enough stimulus to induce HIV-1 protease flap closing, as previously believed. The structural water plays a critical role in flap closing dynamics by destabilizing the hydrophobic clusters and subsequently by mediating the flap-ligand interactions. It is also found that the inhibitors with two carbonyl functional groups would be more potent drug candidates than the ones with single cyclic urea carbonyl group.

- A novel synthetic methodology has been developed to synthesize cyclopentane substituted selenophenes.

- The heterobifunctional reagent synthesized was used for construction of microarrays by immobilization of modified oligonucleotides on glass surface. The regent has potential for further immobilization of biomolecules having thiol functionality, on solid surface for diagnostic studies.

- The receptor based pharmacophore mapping was employed to screen two commercial databases namely, NCI and Leadquest to find new hits for selective GSK-3 inhibition. Further data reduction was brought out by employing filters for drug like molecules like, Lipinski's rule of 5, van der Waals bumps check and by restricting the number of rotatable bonds to a maximum of 7. Molecular docking based method was employed as the final filter to identify 412 hits. Finally, 15 novel classes of molecules were identified as new potential leads for GSK-3 selective inhibition.

- Covalent mimics of the ubiquitous but weak (2–8 kJ/mol) peptide main chain hydrogen bonding interaction (HBI) (>N-H…O=C<) as structure constraining binding elements have been developed. The hydrogen bond mimics (HBMs) are designed to replace a natural main chain HBI at any position between contiguous or non-contiguous polypeptide chains.

- Efficient and simple generic synthetic protocols have been developed for the introduction of alkyl linkers as covalent surrogates for the $i+n$'!i and i'!$i+n$ peptide hydrogen bonding interactions respectively in short peptides. Efficient methods have also been developed for constraining non-contiguous peptide chains into constrained beta-sheet analogues.

- Petromineralological and geochemical characterization of the ophiolitic suite in Manipur, North Eastern India was carried out. Occurrence of high Al Cr-spinels in Abyssal peridotites; existence of High-Ti tholeitic basalts and characteristics of PGE in chromitites and peridotites of Manipur Ophiolitic Complex of Indo-Myanmar Orogenic Belt suggest that the ophiolites of Indo-Myanmar Orogenic Belt is a remnant of the Neo-Tethyan oceanic crust generated at mid oceanic ridge tectonic setting. Peridotites might be representing the residue left after extraction of MORB-type basalt from the source, followed by the crystallization of High-Al Cr-spinel at low degree partial melting.

- Palynological study of Lameta sediments and sauropod coprolites yielded a number of palynomorphs of gymnospermous and angiospermous flora. The phytoliths recovered from the Lameta sediments

indicate diversification of grasses during late Cretaceous in India and origin of rice tribe on the Indian subcontinent. The present study observed two major floral events. First was in the early Maastrichtian during transition from Lameta to Intertrappean and the second was close to the Cretaceous-Paleogene boundary during peak vocanic activity. In the first phase volcanic flows physically came in the basin and terminated the existing vegetation. In the changed condition new floral association developed. This floral association continued for some time in the Deccan Volcanic sequence with diversification and addition of some forms (Lameta Formation and Intertrappean of Ajanta Formation). This phase can well be correlated with the initial phase of Deccan volcanic activity. In the second phase marked deterioration in flora is observed at higher stratigraphic level in the Deccan volcanism sequence. This phase is represented by high fungal growth, highly fungal infected plant debris, record of a few palynomorphs, and sharp increase in mycorrhizal fungi (fungal spike zone). This phase can be correlated with the peak Deccan Volcanism of chron 29R in the subprovince.

The Expert Committee on Engineering Sciences has defined one of its major objective as nurturing young scientists and engineers through identified peers. 5 Young Scientist were identified by the Committee for nurturing during the year. Out of the 9 young scientists nurtured last year 3 scientists who had submitted proposal were awarded the same. Apart from this, the Committee's main activity is to recommend projects with novelty and innovativeness for support. During the last one year period the Committee supported 93 proposals out of 274 proposals received by DST from various institutions.

Recognizing loss of enthusiasm for R&D in engineering institutions, particularly amongst the faculty in NITs and State of Engineering Colleges, the Committee also took up the task of reaching out to these Institutions and facilitating widening the net of researchers in engineering sciences. As is evident there has been a rise in the number of proposals received during this year. It may be interesting to note that almost 25 young scientists who have been supported under the scheme earlier have now been supported under the main SERC scheme through the PACs. A few of them have also been nominated for the INAE Young Engineering Award during last 2-3 years.

The Department had organized 4 Interaction & Review Workshops, (GIW) during the period at Jadavpur University, NIT, Raipur, NIT, Surathkal and Punjabi Universitym Patiala. Apart from these 2 meetings to scrutinize new proposals were also organised one of them in PICT, Pune and the other in New Delhi. The faculty of these Institutions interacted with the Committee members and dissemination of SERC and DST programmes was also done.

During the period 72 ongoing/ completed proposals were reviewed. The individual projects were rated based on the outcome/ progress made as presented by the individual scientists. The summary of the ratings is as follows:

In one of the completed project rated as Excellent the PI is from Bengal Engineering & Science University, Howrah. In 2 other projects in the area of electronics the output has been rated as Excellent and the PIs are from TIFR and CEDT. In addition, a project on Reed Solomon Code where the PI has come up with excellent output has also been rated similarly along with another project which was related to magnetic nano particles production from bacterial culture. The PI who did the first project at IIT, Delhi is now a faculty at IIIT – Bangalore and the other project investigator is from IIT-Delhi. The PI of the completed project at JN Vyas University, Jodhpur which was rated as excellent last year has now been awarded a project under the main SERC Scheme.

Better Opportunities for Young Scientists in Chosen Areas of Science and Technology (BOYSCAST)

The BOYSCAST programme of DST provides opportunities to the young Indian scientists/ technologists below the age of 35 years, who hold regular positions in recognized S&T institutes in India, to visit reputed institutions abroad, interact with scientists there, get exposure to latest research techniques and conduct R&D in frontline areas of Science & Technology. Under the BOYSCAST programme, fellowships of three to twelve months duration are provided every year to the selected young Indian scientists for conducting research/undergoing specialized training in reputed overseas research laboratories/ institutes. During the year, fellowships were awarded to 103 young scientists in the areas including Interface science & engineering, Advanced/smart/novel materials, Nano-science & technology, Electronic materials and processing, Optoelectronics, Microfabrication/Micromachining, Signal processing technologies, Microinstrumentation, Wireless communication, High performance/grid computing, Machine intelligence, Multicriteria decision making including generic algorithms and neural networks, Synthetic methodologies, Heterogeneous catalysis, Supramolecular chemistry, Polymer and surface chemistry, Bioinorganic/Biomimetic chemistry, Molecular electronic structure and dynamics, Ecological engineering, Molecular biology of biotic/ abiotic stresses in plants, Plant microbe interaction, Molecular marker assisted plant breeding, Crop biotechnology, Transgenic plants and animals, Genetic engineering, Reproduction technology, Stem cell research, HIV/AIDS research, Molecular cytogenics, Industrial microbiology, Drug development, Drug delivery system, Vaccine research, Evolution and dynamics of Indian Lithosphere, Geotectonic models and experiments, Seismology, Paleobiogeochemistry, Regional and global climate studies and prediction, Design of efficient numerical/quantitative methods for solving differential equations, Computational fluid dynamics etc. It is envisaged that the expertise gained by these young scientists/technologists during the fellowship period will lead to initiation/strengthening of the national programmes in these areas as well as further generation and spread of expertise at the national institutes.

The Kishore Vaigyanik Protsahan Yojana (KVPY)

Under the attractive scholarship and training scheme, Kishore Vaigyanik Protsahan Yojana (KVPY), about 370 students were selected.

For the students continuing in the Scheme, summer training programmes were again organized this year in a number of institutions across the country. Based on their scholastic performance in their respective courses of study and their performance in the summer training programme, the scholarship was renewed.

Science Olympiad Programmes

The Indian teams again performed very well in the International Mathematics, Physics, Chemistry and Biology Olympiads. The medal tally this year was as follows: in Mathematics : 3 Silver, 3 Bronze medals and 1 Honourable Mention; in Physics : 4 Gold, 1 Silver; in Chemistry : 4 Silver; and, in Biology: 1 Gold, 2 Silver and 1 Bronze medals.

Assistance for Participation in International Conference

The objective of the scheme is to provide travel assistance to the Indian Scientists working in educational/ academic institutions and National R&D laboratories enabling them to participate in the International Conferences/Workshops etc. This provides an opportunity to the Indian scientists to interact with their foreign counterparts which enable them to present their findings and results at an International level for a better peer reviewing.

During the year, 1455 candidates supported out of total number of 3540 applications received. Out of this, about 576 young scientists were supported towards travel grants to participate in International Conferences/Workshops, training Programmes etc. Some of the important conferences were World Cong. on Engg. And Computer Science,World Congress on Ophthalmology, Int.Conf.on Carbon, Materials for Advanced Technologies, Int.Conf.on Computational Methods & Function Theory, Int. Conf. on Plasma Science, Int. Conf. on Green & Sustainable Chemistry, Int. Chemical Conf. etc.

Seminar/Symposia and Assistance to Professional Bodies

The scheme for seminar/symposia and assistance to professional bodies aims to promote active involvement of Professional S&T Bodies and Science Academies for National Development; encourage and support Professional S&T Bodies and Science Academies for promoting interaction amongst themselves, fermentation of new ideas for societal development and extend financial, logistic and administrative support to scientific groups and scientific institutions/universities in the country for organising scientific events. About 550 International and national conferences/workshops were supported in this period.

Sophisticated Analytical Instrument Facilities (SAIF)

The Department of Science & Technology has set up Sophisticated Analytical Instrument Facilities (SAIFs) in different parts of the country to provide the facilities of sophisticated analytical instruments to the research workers in general and specially from the institutions which do not have such instruments through its (SAIF) programme to enable them to pursue R&D activities requiring such facilities and keep pace with developments taking place globally. At present the Sophisticated Analytical Instrument Facilities (SAIFs) are being supported by DST at IIT, Chennai; IIT, Mumbai; CDRI, Lucknow; Panjab University; Chandigarh; NEHU, Shillong; Nagpur University; Nagpur; IISc., Bangalore; AIIMS, New Delhi, Gauhati University, Guwahati; IIT, Roorkee, CVM, Vallabh Vidyanagar and Sophisticated Test & Instrumentation Centre (STIC), Kochi.

Analytical Instrument Facilities Available at the SAIFs

The SAIFs are equipped with instruments such as Scanning Electron Microscopes, Transmission Electron Microscopes, Electron Probe Microanalyzer, Mass Spectrometers, ICP, NMR, EPR Spectrometers, X-ray Diffractometers, Thermal Analysis Systems, etc. to meet the needs of research workers in various areas of science & technology. Instrument facilities were strengthened during the year in the areas of Electron microscopy, Molecular characterization/structure determination and Surface analysis to meet the current and emerging needs of the research community. Some of the major instrument facilities installed at the SAIFs during the year are: High Resolution Scanning Electron Microscope with EDAX & WDS at the SAIF, Chennai, Secondary Ion Mass Spectrometer and FT-IR Imaging System at the SAIF Mumbai, 400 MHz FT-NMR Spectrometer at SICART Vallabh Vidyanagar and the SAIF, Kochi. The following instrument facilities are further being added to the existing SAIFs to strengthen them: Vibrating Sample Magnetometer at the SAIF Chennai, Q-TOF HR Mass Spectrometer at the SAIF, Lucknow, 200 KeV Transmission Electron Microscope at the SAIF, New Delhi and Single Crystal X-ray Diffractometer at the SAIF, Kochi. The SAIFs over the years have acquired the capabilities of repair and maintenance of instruments and majority of the instruments with them are being maintained in-house.

Services Provided/ Other Activities Undertaken

Analytical services

- A wide range of sophisticated analytical instrument facilities/techniques are being provided by the SAIFs to the research workers. The instrument facilities at the SAIFs are meeting the analytical needs of scientists including qualitative/quantitative elemental, molecular/compound analysis/ characterization, structure determination, microstructure analysis and surface topographic studies etc., and enabling them to pursue research in various frontline areas of S&T.
- Consultancy services like solution to analytical problems including development of analytical methods for specific needs, sampling problems, spectrum analysis and interpretation of results etc. are also being offered by the SAIFs. Facilities and assistance for sample preparation are also being provided to the users.
- The facilities at the SAIFs facilitated research in various areas of Science & Technology. Some of these include synthesis of a variety of organic compounds, drug intermediates, extraction/study of natural products/screening for their biological activities, drugs & pharmaceutical research, study of biomolecules and their structure elucidation, Research in consdensed matter physics/material science, nano-science & technology, studies related to crops/seeds, insecticides, various diseases, etc. About 700 research papers were published by the users of the SAIFs with the support from the facilities provided.
- About 12,500 scientists/users from all over the country utilized the facilities during the year. These included research workers from almost all the universities in the country. About 83% of the users were from academic sector.
- About one lakh samples were analyzed at the Facilities during the year.

Training programmes/workshops

Training programmes/workshops were organized by the SAIFs on use and application of various instruments and analytical techniques to create awareness among the research community about them and on maintenance/repair/operation of the instruments for technicians. Some of the training programmes/ workshops organized are as follows:

- Training programmes on Electron Microscopy for research workers/technical personnel by SAIF, New Delhi.
- A workshop on '1D and 2D NMR techniques' by SAIF, Chennai.
- A national school on 'A new direction to NMR: From molecules to human behaviour' by SAIF, Bangalore.
- A workshop on 'Mass Spectrometry' by SAIF, Chennai.
- A workshop on 'Chromatography and Mass Spectrometric Techniques' by SAIF, Kochi.
- A workshop on 'Spectrographic, Chromatographic and Microscopic techniques of analysis' by SICART, Vallabh Vidyanagar.

- A workshop on 'UV-VIS-NIR and Fluorescence Spectroscopy' by SAIF, Chennai.
- A workshop on 'Instrumentation and Applications of Thermal Analysis Systems' by SAIF, Chennai.
- A workshop on 'Thermal Analysis Techniques' by SAIF, Kochi.

Analytical techniques developed/significant analysis done/research work facilitated

Some of the analytical techniques developed/significant analysis done/research work facilitated by the SAIFs are as follows:

- The compound Nymphayel ($C_{25}H_{42}O_1$) extracted from Nymphae Stellata (Wild Lily from Tamil Nadu) is found to have excellent ability for regenerating the ²-cells. One of the reasons for insulin dependent diabetics is depletion of ²-cells in the islet of Langerhans in the pancreas. The structure of compound Nymphayol was solved at the SAIF, Chennai.
- Deterministic Bell state discrimination has been carried out by NMR using qubit system at SAIF, Bangalore. Experimental implementation of quantum Ulam's problem has also been carried out using again a three qubit system.
- Single file diffusion of confined water inside a single wall nano-tube was studied by NMR diffusion measurements at SAIF Bangalore.
- A new chiral medium based on small fragments of DNA has been proposed for the first time for enantiomeric discrimination of water soluble molecules. The medium has advantage that it can be used for the study of protein-DNA interactions also. The work has been facilitated at SAIF, Bangalore.
- New methodologies for rapid NMR data collection have been developed for application to structural and functional studies of large molecular weight proteins. The work was facilitated at SAIF, Bangalore.
- Dose-dependent cardioprotective effect of leaf extract from medicinal plants, Moringa oleifera and Commiphora mukul in isoproterenol-induced acute myocardial necrosis in rats was studied at AIIMS, New Delhi. TEM study done at the SAIF, New Delhi provided confirmatory evidence for cardioprotective effects of both plant extracts as revealed from reversal of injured mitochondrial and myocyte ultrastructure in isoprovenol-induced damage myocardium to normalcy following treatment with these drugs.
- The work on elastic liposome's bearing melatonin resulted in demonstration of their feasibility for transdermal delivery of melatonin that provides better transdermal flux and possesses the ability of a self-penetration enhancer as compared to conventional liposomes. The work was facilitated at SAIF, New Delhi.
- A method to measure the Dry Rubber content in natural rubber latex by determining the change in enthalpy of unit mass of the sample in a definite temperature range with DSC was developed at SAIF, Kochi.

High Resolution Electron Microscope with EDAX and WDS at the SAIF, Chennai

Secondary Ion Mass spectrometer at the SAIF, Mumbai

FT-IR Imaging System at the SAIF, Mumbai

400 MHz FT-NMR Spectrometer at the SAIF, Kochi

Utilization of Scientific Expertise of Retired Scientists (USERS)

USERS scheme aims to utilize the expertise and potential of large number of Eminent Scientists in the country who remain active and deeply motivated to participate in S&T development even after their retirement. The main activity under this programme is preparation of books/monographs and state of art-reports. Several retired scientists have been supported and 18 projects were sanctioned during this financial year. Some of the important projects commissioned during the year include: Climate change and agriculture-green house gases and crops; Pathogenesis of animal bacterial diseases; Biofungicide: strategies for enhancing the efficacy in the management of plant diseases; Dye Sensitized solar Cell: principle and state of art; Recommended standard practices in the field of static force, pressure & torque metrology; Mosquito vectors of japanese encephalitis virus from northern India; Diversity, ecology and managemen of termites in forest ecosystem; Hazardous & Household Waster Materials - Methodologies & Techniques for risk assessment and containment; Statistical Analysis of Indian Monsoon Rainfall; Quantum field theory in medium (with applications to hadron propagation and heavy-ion collision).

Fund for Improvement of S&T Infrastructure In Universities and Higher Educational Institutions

"**FIST" - Fund for improvement of S&T infrastructures in universities and higher educational institutions** scheme was started in 2000 for augmenting PG teaching and research activities in all science departments of Universities, Colleges and other Academic Institutions in the country. The Scheme has been conceptualized with an objective of augmentation of science departments either engaged in imparting PG teaching or actively involved in research activities so that more students can be attracted to pursue their carrier in higher studies in new and emerging areas of science.

Financial support is provided to acquire state-of-art equipment besides basic equipment, renovation of existing infrastructure, augmentation of facilities available in the department and setting up of Computer centre in the department. The Program generally extends support in six broad subject areas of S&T i.e. Life Sciences, Physical Sciences, Chemical Sciences, Engineering Sciences, Earth & Atmospheric Sciences & Mathematical Sciences through two levels of support.

About 160 proposals (in Level I and Level II Category) have been recommended for support with a budget of Rs 142.15 Crores. In addition, FIST Support has been made available to the ongoing FIST Proposals. Further about 80 proposals (in Level I and Level II Category) from various Universities and Institutes have also been recommended for support under FIST 2009 by FIST Advisory Board. The total recommended budget for FIST Program (for Departments in Universities and Institutes) in the year 2009 is Rs 91.60 Crores. Already 60 proposals have been processed for support under FIST Program this year.

"Special S & T Support to North East Region" under FIST Programme

Towards augmentation of the S&T infrastructure and Research and Training in the NER Universities and their affiliated colleges, the Department of Science and Technology allocated about Rs.70.00 crores for five years. The allocation was distributed over several heads viz, support to 58 UG colleges, three types of fellowships, Major facilities in a consortium mode, Teaching support to University Departments, Stabilized power Supply and for Research projects on region specific themes. Activity-wise achievements are given below:

Support to Under Graduate Colleges

Total 58 colleges, affiliated to 12 Universities in NER, were identified for the support. An amount of Rs. 50.00 lakhs was allocated to each college for equipments, lab renovation, computer lab and maintenance. North East Institute of Science and Technology (NEIST) has been entrusted the responsibility of implementing this project which includes procurement of equipments, their installation and monitoring the progress. The individual colleges have taken up the responsibility of the lab renovation related aspects directly. During the first phase, Rs.586.00 lakhs was released to NEIST for lab renovation and setting up of computer lab during 2008-09. Out of this NEIST has disbursed Rs.5.00 lakhs directly to each college for lab renovation and procured the computers and networking items for all the 58 colleges and arranged the installation at the respective locations. The procurement process was guided by Technical Committee with representatives from NEIST, few Universities and DST.

Setting up of Computer Lab

A common configuration was designed by NEIST for all 58 colleges and the design was provided to each college for renovation. The renovation of the computer lab was done by the colleges with the funds provided to them by NEIST. The following items for computer labs were procured by NEIST and installation was completed at all 58 colleges. The computer lab was equipped with 7 computers, one server, Printer, UPS and AC.

Lab Renovation: The lab renovation was also completed by all the respective colleges.

Till date, NEIST's Team has inspected the colleges namely: **Tripura** : Maharaja Bir Bikram College, Agartala; Womens' College, Agartala; Belonia College, Belonia; Ramkrishna Mahavidyalaya, Kailashahar; **Manipur** : DM College of Science, Imphal; Modern College, Imphal; GP Womens' College, Imphal; Manipur College, Imphal; **Assam** : Gurucharan College, Silchar; Cachar College, Silchar; Karimganj College, Karimganj; Srikishan Sarda College, Hailakandi; Dibrugarh HS Kanoi College, Dibrugarh; Duliajan College, Duliajan; Jagannath Barooah College, Jorhat; Science College, Jorhat; Dergaon Kamal Dowerah College, Dergaon; Lakhimpur Girls' College, Lakhimpur, North Lakhimpur College, Lakhimpur; Dibru College, Dibrugarh; Tinsukia College, Tinsukia; Sibsagar College, Joysagar; Debraj Roy College, Golaghat; Moran College, Moranhat; Nowgong College, Nagaon; Morigaon College, Morigaon; Darrang College, Tezpur, Lokanayak Omeo Kumar Das College, Dhekiajuli; Kaliabor College, Kuwaritol; **Arunachal Pradesh** : Dera Natung Govt. College, Itanagar; **Nagaland** : Patkai Christian College, Dimapur and Kohima Science College, Kohima.

The team from NEIST reported that the progress on Lab renovation and setting up of the computer lab is very satisfactory.

The second installment of Rs.586.00 lakhs has been made to NEIST towards the procurement of the equipments for teaching for all 58 colleges during 2009-10. List of equipments to be procured has been finalized by NEIST and Procurement process initiated.

It was recommended that three types of fellowships may be supported viz., (i)Visiting Professor to NER Universities; (ii) Visiting Faculty to outside NER and (iii) Visiting Student Fellowship to outside NER.

The responsibility of implementation of the Fellowship component was entrusted to Jagadis Bose National Science Talent Search (JBNSTS), Kolkata. The details of the fellowships availed by the candidates is given below:

Visiting Professor to NER University (one Month) – 6 Nos

Visiting Faculty to Outside NER (One Month) – 6 Nos

Visiting Student to Outside NER (Three Months) – 10 Nos

The requirements for Fellowships submitted by the respective Universities for the year 2009-10 are under process.

Summer / Winter Schools

The eight following Summer/ Winter Schools were supported

I. Central Agriculture University, (Mizoram campus)
Title: S/W School on "Recent advances in molecular and immunological techniques for diagnosis of bacterial diseases of livestock and poultry"

2. Dibrugarh University
Coordinating Department: Department of Statistics, Dibrugarh University

Title: S/W School on "Statistics for UG Students"

3. Gauhati University
Coordinating Department: Department of Geography, Gauhati University
Title: S/W School on "Micro-level area study for evolving strategies for sustainable development"

4. Mizoram University
Coordinating Department: Department of Geology, Mizoram University
Title: S/W School on " The neogene palaeobiology, sedimentology and stratigraphy of the NE Region"

5. North Eastern Hill University
Coordinated by UGC-Center for advanced studies in Botany, NEHU.
Title: S/W School on " Recent advances in plant Science"

6. Rajiv Gandhi University
Coordinating Department: Department of Zoology, RGU, Arunachal Pradesh.
Title: S/W School on "Rice fish integrated farming technique for high altitude west rice land"

7. Tezpur University
Coordinating Department: Department of Chemical Sciences, Tezpur University.
Title: S/W School on "Green Chemistry"

8. Tripura University
Coordinating Department: Department of Zoology, Tripura University.
Title: S/W School on " Taxonomy and identification on Hemiptenran insects of economic importance"

Fresh proposals for the current financial year are being requested.

Stabilized Power Supply to Universities in NER

It was recommended that a one time support to improve the power quality in the NER universities may be provided up to Rs.50.00 lakhs to each University. So far, the following Universities have been supported during 2008-09 and 2009-10:

University	F.Y	Sanctioned Rs. in Lakh	Released Rs. in lakh
Mizoram University, Aizwal	2008-09	50.00	40.00
Central Agriculture University, Manipur	2008-09	50.00	40.00
North Eastern Hill University, Shillong	2008-09	50.00	40.00
Tripura University, Agartala	2009-10	43.00	40.00
Tezpur University, NAPAAM, Tezpur	2009-10	17.00	15.00
Manipur University, Canchipur, Imphal	2009-10	20.00	18.00
Dibrugarh University, Dibrugarh	2009-10	37.50	35.00
Rajiv Gandhi University, Itanagar	2009-10	35.00	30.00

The supported systems are being procured now.

Support for Teaching Equipment to Universities in NER

An amount of Rs.150 lakhs was allocated to each University. However, the Expert Committee after reviewing the individual proposals recommended Rs.120 lakhs for the state Universities and Rs.80.00 lakhs for the Central Universities in NER. Accordingly, the following Universities have been supported for the Teaching Equipment. The support is spread over 5 years including maintenance.

University	F.Y	Sanctioned Rs. in Lakh	Released Rs. in lakh
Tezpur University	2008-09	80.00	40.00
Manipur University	2008-09	66.00	30.00
Tripura University	2009-10	61.00	35.00
Gauhati University	2009-10	97.00	50.00
North Eastern Hill University	2009-10	80.00	50.00
Rajiv Gandhi University	2009-10	73.00	50.00
Mizoram University	2009-10	73.00	50.00

So far, an amount of Rs.17.47 Crores has been released to these support areas under this package.

Major facility Support

The matter was extensively discussed during first 4 meetings of the Expert Committee. Due to the non-convergence of the deliberations regarding selection of the locations, the Expert Committee suggested that a sub-Group may visit the NER Universities for on the spot assessment of the requirement by the University, Expertise available and to finally select the locations. The Expert Committee during its 5th

meeting held at Itanagar in April 2009, reviewed the sub-Group's recommendations and identified the locations and the facility to be established as given below:

Gauhati University: High Performance Computational facility with 64 nodes cluster and software

Tezpur University: Powdered XRD Facility with High and Low Temperature systems

Tripura University: 400 MHz NMR facility

Mizoram University: High Resolution TEM facility

The proposals on the above major facilities are being formulated by the respective Universities.

Coordinated Research Projects specific to NER region.

Proposals are being formulated by the respective Universities as per the recommendations of the Expert Committee.

PURSE PROGRAMME

In appreciation of the R & D contributions of the performing universities, PURSE initiative is taken by Department of Science & Technology, Government of India to initiate value added proactive measures through introduction of R & D Incentive Grant. PURSE scheme provides substantive research grant to grant to 14 Universities on scientific publications in Science Citation Indexed Journals.

The following table illustrates the quantum of support, as approved by the Department to 14 Performing Universities based on H-index.

S. N.	University	H-Index	Research Grant
1.	University of Delhi	56	Rs.10.0 crore per year for 3 years
2	University of Hyderabad	54	
3	Punjab University	50	
4	University of Pune	44	Rs.5.0 crore per year for 3 years
5	Jadavpur University	43	
6	Banaras Hindu University	42	
7	University of Madras	37	Rs.3.0 crore per year for 3 years
8	University of Bombay	37	
9	Jawaharlal Nehru University	33	
10	Anna University	31	
11	Karnataka University	30	
12	Aligarh University	30	
13	University of Rajasthan	27	Rs 2.0 crore per year for 3 years
14	Andhra University	26	

Under PURSE Initiative, DST intends to provide support to these universities essentially for research man-power cost, augmentation of equipment and computational facilities, research consumables, organization of scientific conferences/workshops, travel and maintenance of the facilities.

Total budget of PURSE Program is Rs 201.0 Crores for three years. The first installment of Rs 67.0 Crores have been made available to all 14 Universities.

INDIA-UK Science Bridges Awards & Next Generation Network

Towards enrichment of linkages between India and UK, DST and Research Council (RC) United Kingdom have instituted the Science Bridges Award Program including Next Generation Network Systems.

Three projects namely "Sustainable Indo-UK Agricultural Initiative from IISc, Bangalore and IARI, New Delhi, "The Science and Business of Translation in Pharmaceutical Sciences and Biotechnology" from IIT Kanpur and IIM Bangalore and "Bio-Energy: Technology and Business Solutions for UK and India", from IIT Delhi have been supported under this Program with a budget of Rs 1268.0 lakhs for three years. Under this Program another Project on "Excellence in Next Generation Networks" from IIT Madras have been supported with a budget of Rs 1483.0 lakhs for 30 months.

DST-India and RC-UK Research Initiative on Solar Energy

The Department of Science and Technology and the Engineering and Physical Sciences Research Council (EPSRC), UK on 23 April 2009, signed a cooperation agreement to co-fund a joint research initiative in solar energy. Under this agreement, UK and India each has committed to contribute up to 5 M UK Pounds for this call over a three year period. The agreement conveys the two countries to cooperate towards fostering of genuine and mutually beneficial research to develop novel materials, devices and systems applicable to solar energy.

Two out of Eight proposals received under this program have been recommended for Support.

Sr. no.	*Proposal Title*	*Lead Partner - India*	*Lead Partner - UK*	*Cost Requested from EPSRC in Pound Sterling*	*Cost requested from DST in INR in lakh*
1	Advancing the efficiency and production potential of exictonic solar cells (APEX)	Dr Suresh Chand NPL, New Delhi	Prof Hari Mohan Upadhyay, University of Loughborough	2490440.92	1993
2	Stability and performance of Photovoltaic (STaPP)	Prof Rajesh Gupta, IIT Bombay	Dr Ralph Gottachalg, University of Loughborough	2365814.38	1824.42

These proposals are being funded from SERC (R &D) Program of DST for supporting the Indian side.

INSPIRE Program

"Innovation in Science Pursuit for Inspired Research (INSPIRE)" is one such innovative programs proposed by the Department of Science & Technology for attraction of talent to science. The basic objective of INSPIRE would be to communicate to the youth population of the country the excitements of creative pursuit of science and attract talent to the study of science at an early stage and build the required critical human resource pool for strengthening and expanding the Science & Technology system and R&D base.

INSPIRE Scheme has included three components. These are : a) Scheme for Early Attraction of Talents for Science (SEATS), b) Scholarship for Higher Education (SHE) and c) Assured Opportunity for Research Careers (AORC).

Scheme for Early Attraction of Talent (SEATS) aims to attract talented youth to study science by providing INSPIRE Award of Rs 5000 to one million young learners of the age group 10-15 years and arrange a summer camp for about 50,000 youth in more than 100 locations for toppers in Class X board examinations with global leaders in science to experience the joy of innovations on an annual basis through INSPIRE Internship.

Scholarship for Higher Education (SHE) aims to enhance rates of Attachment of talented youth to undertake higher education in science intensive program by providing scholarships and mentoring through summer attachment to performing researchers. The scheme would offer 10,000 Scholarship every year @ Rs 0.80 lakh per year for undertaking Bachelor and Masters level education in natural sciences for the talented youth in the age group 17-22 years. The main feature of the scheme is in mentorship support being planned for every scholar through INSPIRE Scholarship.

Assured Opportunity for Research Careers (AORC) aims to attract, attach, retain and nourish talented young scientific Human Resource for strengthening the R&D foundation and base by offering doctoral INSPIRE Fellowship in the age group of 22-27 in the both basic and applied sciences including engineering and medicine and assured opportunity for post doctoral researchers through a scheme (similar to that of new blood program of the Royal society of UK) through contractual and tenure track positions for 5 years in both basic and applied sciences areas through an INSPIRE Faculty Scheme. This will be renamed as 'Dr Homi Bhabha Centenary post-doctoral Research Faculty Position' Scheme

Government of India has approved this program in November 2008 at a total cost of Rs 1979.25 crores in the 11th Plan Period and Hon'ble Prime Minister launched the Program on 13th December 2008.

The INSPIRE Award for the students in the class ranging from 6th to 10th standard of 20. States and UTs have been finalized and a total of about 1.1 lakh students have been recommended. 41,000 Debit Warrants of Rs 5000 per Award have already been handed over to the respective States and the remaining warrants are being prepared. The recommendations from States like Uttar Pradesh, Orissa, Sikkim are presently being processed.

Besides this in a science camp about 12,000 INSPIRE Internship in about 55 Science Camps across all states in the country for the students who are top 1% in Class XI Board examinations, has also been given exposure with the Science Leaders in the country including Noble laureates.

During the last one year, 1700 INSPIRE Scholarships to the students pursing the 5 years Integrated MS/ MSc degree in different science courses at five Indian Institute of Science Education & Research

(IISERs), National Institute of Education & Research (NISER), Indian Institute of Technology (IITs), Indian School of Mines (ISM) have been awarded under the Scholarship for Higher Education component of INSPIRE program. About 700 INSPIRE Scholarships to the students who are common top 1% in Class X and Class XII Board Examinations and pursing the BSc – MSc or 5 years Integrated MSc degree at the various Colleges and Universities are finalized. The applications for the remaining students doing graduate course in science have been received now for the award of INSPIRE Scholarship under 'Scholarship for Higher Education (SHE) component of the whole INSPIRE program and shall be awarded shortly.

Under INSPIRE Fellowships, about 80 Fellowships have been finalized now based on the First Rank holder in their post-graduate/ under-graduate programs and pursing doctoral degree at the University or any other academic Institutions in the country. Another 280 Fellowships are being finalized shortly.

SPECIAL S & T SUPPORT TO JAMMU AND KASHMIR

The Department initiated a special S&T support to Jammu and Kashmir for the augmentation of infrastructure in the University Departments and affiliated colleges. Towards this endeavor, Secretary, DST met all the Vice-Chancellors of the Universities in the State on 2nd May 2009. During the meeting, support totaling over Rs.600 lakhs for five years was recommended for various schemes such as support to UG colleges (about 35 Nos), three types of fellowships (visiting professorships for senior faculty from other regions of the country to teach in universities in J&K region; visiting positions for young faculty of J&K for research in other region of India for duration of 3-6 months and fellowships for doctoral students from J&K for work in other regions of India), Stabilized Power Supply, teaching support, Major facility support, summer/ winter schools and focused R & D support.

In order to oversee the implementation of the whole support, DST constituted an Expert Committee. The Expert Committee met in July 2009 at University of Jammu and in December 2009 at SKUAST, Jammu to discuss the modus operandi for implementation of the DST support on various categories of support. University of Jammu and University of Kashmir have offered to implement the support to Under Graduate Colleges affiliated to them. Progress achieved so far is given as follows:

Under Graduate College Support

Total 18 under graduate colleges affiliated to University of Kashmir have been supported at a total cost of Rs.900 lakhs @ Rs.50 lakhs each for teaching equipments,computer lab, laboratory renovation, books and maintenance. Initial release of Rs.540 lakhs has been made for this purpose.

Total 16 under graduate colleges affiliated to University of Jammu have been supported at a total cost of Rs.710 lakhs @ Rs.50 lakhs each for teaching equipments, Computer lab, laboratory renovation, Books and maintenance. Initial release of Rs.426 lakhs has been made for this purpose.

Stabilized Power Supply

In order to overcome the Power Fluctuations in the Universities in J&K State, it was proposed to provide financial assistance upto Rs.50 lakhs to each University. This support includes power back up systems/ generators which can cater to the Science/ Engineering Departments of the University. So far University of Kashmir, Srinagar; Baba Ghulam Shah Badshah University, Rajouri; Shri Mata Vaishno Devi University, Jammu; Sher-e-Kashmir University of Agricultural Science and Technology (SKUAST), Jammu and University of Jammu, Jammu have been supported.

Teaching Support

Baba Gulam Shah Badshah University, Rajouri and Shri Mata Vaishno Devi University, Jammu have submitted the proposals which and are being processed.

The remaining areas of support such as Fellowships, Major Instrumentation facility, Research projects etc. will be supported during the subsequent years.

CHAPTER 2

TECHNOLOGY DEVELOPMENT PROGRAMME

Technology Systems Development (TSD) Programme supports activities aimed at developing and integrating technologies to evolve technology systems both in the advanced/emerging areas and in traditional sectors/areas. Under the Programme, feasibility of fresh ideas/ concepts is assessed for their potential conversion into useful technology/ product. Applications of R&D for socio-economic benefits is consciously promoted under this programme. The focus is on inter-disciplinary, multi-institutional technology feasibility and development of technologies in certain identified areas.

The primary objective of the Programme is to facilitate and support development of products or techniques/ technology aimed at specific end use. The Programme stresses on clearly identifying the needs for development of the technology so that the developmental effort could be useful to the target beneficiary. It envisages active user involvement and association in the development effort. The intention is that the products/ technologies developed under the Programme become useful for the benefit of the people at large. The specific objectives of the Programme are to:

- Develop and integrate technologies following a holistic approach in identified areas;
- Promote application of modern/ advanced technologies to socio-economic problem solving;
- Promote modernization of traditional technologies, tools and skills;
- Facilitate enhancement of quality and performance of the traditional/ non-traditional items;
- Encourage developments in application of R&D activities; and
- Promote initiatives aimed at improving technology, technique, material, methods and other appropriate activities conducive for development of technology status in identified areas.

Summary of the progress made during 2009-10 in some of the important areas, on technology development are enumerated as follows:

WATER PURIFICATION

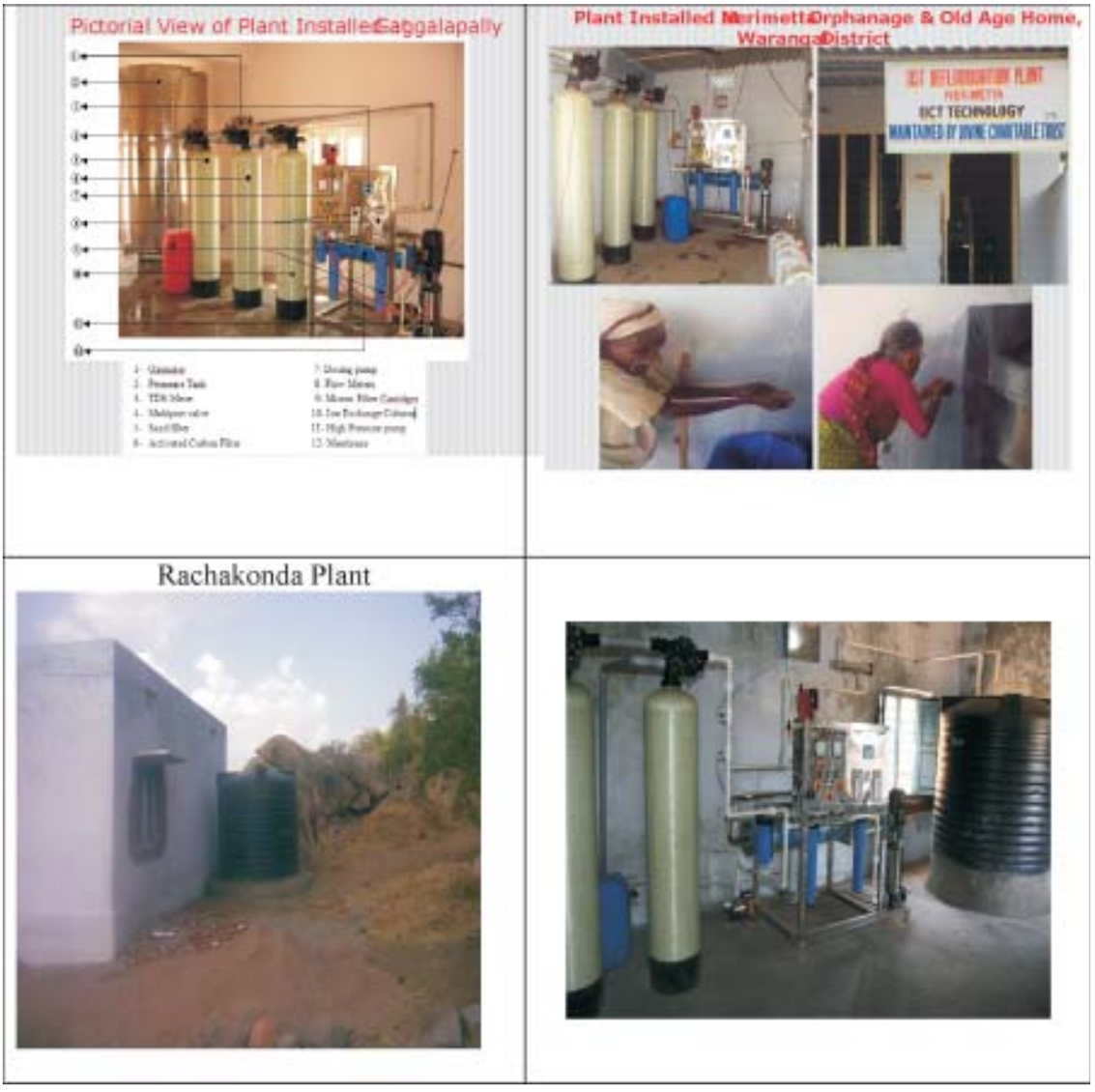
Under this area, the focus was primarily on developing technologies specifically for removal of arsenic, fluoride, salinity and iron.

Replication of Defluoridation Plants for Ground water Purification in Affected Areas of Andhra Pradesh

Fluorosis is a serious health problem faced by humans and livestock in several States in India due to the presence of excessive fluoride in ground water. Andhra Pradesh and Rajasthan are two of the most widely affected States. The permissible level of fluoride in groundwater is 1.0 ppm as per Bureau of Indian Standards and 0.5 ppm according to W.H.O. regulations. Groundwater in Nalgonda District of Andhra Pradesh State contains up to 20 ppm fluoride which is the highest in the world as per W.H.O. statistics.

Parochial methods adapted in Nalgonda district, which involve removal of fluoride by adsorption, suffer from disadvantages such as poor fluoride removal efficiency, inability in separating other impurities (e.g; dissolved salts, microorganisms, etc.), low flow rates and high operating costs.

This project involved application of Reverse Osmosis (RO) technology for the removal of fluoride and other impurities from drinking water. IICT conducted research on a pilot scale system using commercially available membranes and designed a model defluoridation system which includes extensive pretreatment such as sand filtration, exposure to activated carbon, hardness removal and anti-scalant dosing to enable long membrane life. Effective post treatment using UV and ozonization was also incorporated to ensure high purity and quality of the product water. Five reverse osmosis plants of 1000 L/h capacity each have been installed in the fluoride affected areas of the Andhra Pradesh during the year.



Installation of RO membrane based hybrid plant in Andhra Pradesh for the treatment of water containing excess fluoride : A solution for the production of pure drinking water with safe concentrate disposal

Information & Communication Technology (ICT) Systems

Under this area, the focus is on developing technologies, which promote application of information technologies for the benefit of general masses especially rural people. Following projects were completed/ supported in this area during the year:

- Design and development of Test Bench for Sound and Vibration Analysis in Electrical Machines using Virtual Instrumentation.
- Development of wireless sensor network based automated feed uptake and animal development monitoring scheme for semi-rural dairy operations.
- Development of multi-agent based system for dynamic multi-project scheduling.

To develop and validate a mode telemedicine facility in Ophthalmology using indigenous equipment at Venu Eye Institute , New Delhi

The diseases managed at the Vision Centre included a wide array of conditions ranging from simple refractive error to infectious conditions of the ocular surface. Surgical cases (e.g. Cataract) or those requiring specialized intervention (e.g. Retinal diseases) were identified and referred to the nodal hospital. Post cataract surgery patients from the secondary and tertiary hospitals were also followed up at these Vision Centres, through tele-consultation. Patients presenting at the Vision Centres were also able to interact with the doctor posted in the nodal hospital through the tele-ophthalmic set-up. Tele-Ophthalmology provides state-of-the-art healthcare services (in eye) to needy patients in remote rural areas. It bridges geographical & economical divide and provides a replicable model for further community empowerment through education & improved awareness of healthcare. The project was successfully completed during the year.

Integration of knowledge System on Soil Nutrient Management through Image Processing of Chromatograms

The new technology developed gives acceptable level of accuracy (>90%) for all nutrients except organic Carbon (70%), Sulphur (72%) and Zinc (80%) compared with conventional analytical methods**.** Software for image processing of soil chromatogram so as to know the soil composition, fertilizer recommendation and best suitable crop has been developed and tested at various levels. More than 12,000 soil samples have been processed for circular Paper chromatograms, image processing and case-based reasoning.. A manual on Alternative analytical technology was prepared and published on workshop. Establishment of 3 laboratories in Andhra Pradesh and 2 laboratories in Tamil Nadu are in progress for testing farmer's soil samples free of cost. The technology for alternative analytical technology for soil testing is protected under patent application.

Surface Engineering modification and rejuvenation of Traditional Crafts

The main objective of this program was to explore the possibility of application of advanced Surface Engineering technologies to improve value addition of traditional crafts and modernization of traditional techniques, tools and skills with a view to enhance export capabilities and performance of traditional and non-traditional items.

Eco-friendly and user friendly machines for hank processing cottage industry

Under the project, user friendly machines for hank processing and pirn sizing were developed as per the required technical specifications. Operating handle of the machine was also purposely kept away from

actual dyeing bath to avoid constant exposure to heat and chemicals. The machine is placed at Solapur (Maharashtra) and Rabkavi-Banhatti (Karnataka) clusters. Accordingly, field trials were carried on the developed machines with use of conventional synthetic dyes. Fabric has been prepared on sample loom with yarn dyed on these developed machines. Similarly trials for natural dyes (for 2 shades, brown and yellow) on the machine were carried.

Hank Processing Machine

The developed hank dyeing machine and pirn sizing machines have proved to be user-friendly because of provision of partial mechanization of the hank/ yarn movement. The exposure of worker to the chemicals, auxiliaries, high temperature is reduced on the developed machines as compared to the conventional hank dyeing process. The configuration of the developed prototype model is very simple and it can be modified as per the production and process requirement. As far as handloom cottage industry is concerned, it suits the production requirement and is useful for different production levels. Thus the project was successfully completed during the year.

Innovative Civil Infrastructure Technology Systems

The progress of the project entitled "Distress Dignostic Performance Evaluation for Bridge Management System for Concrete Bridges– Phase-II i.e. Development of a Prototype of Visual Inspection Unit at MERADO, Ludhiana was reviewed during the year.

Glass Technology Upgradation

Following projects were initiated during the year: "Development of sol-gel based low e-indium Tin Oxide (ITO) coatings on glass for different applications" ,"Design and development of precision biaspheric polycarbonate lenses for indirect ophthalmoscopy (20D & 28D)", "Development of contemporary design for unorganized small scale sector of Firozabad Glass Cluster".

Bimolecular Electronics & Conducting Polymers

Under this sub-area, technology feasibility and development projects in the area of Bio-Molecular Electronics, conducting Polymer electronics and Bio-sensors were catalyzed. Some of the important projects supported during the year are:

"Process Development for production of bacteriordopsin by halobacterium species for application in nano-device development" ,"Synthesis and scale up of high contrast processable electrochromic polymers based on conjugated dialkoxythiophenes", "Study of phthalocyanine- polyaniline-composite thin film for use as suitable materials in solar cells", "Development of novel free redical biosensor based on embedded system", "Development of hybrid solar cells", Polymer nanocomposites for flexible electronic applications", "Development of Biosensor for measurement of glucose concentration in body fluids non-invasively","Development of Electrochemical Biosensors for monitoring pesticides in water, soil and food samples", "Design an dfabrication of efficient white organic light emitting diode", "Developemnt of Polymer based sprintronik devices", "Development of the prototype of saw sensors for NOx gas", "Fabrication of energy efficient hybrid organic light emitting device (OLED) on nano structure templates for white lighting applications", "Development of high efficiency, low cost dye sensitized solar cells", "Metal Oxide Polymer nano composites for detection of gas pollutants in sugar industries", "Integrated all Optical swiching using bacterirdopsin", "Development of halobacterial variants for enhanced bacterirdopsin (Br) protein production",

"Study of Optical power limiting characterstic of bacterirdopsin for the design of detector protection system", "Design of optical logic gates with bacterirdopsin", "Development of photochromic thin film of bacteriordopsin", "Hybrid Structures: Use of semiconducting nano particlesin Donar/ Acceptor type Organic Solar Cells", "Development of nano porous TiO2 electrode and modified solid polymer electrodes for dye sensitized solar cells (DCSS)", "Development of Organic Piezoelectric Sensor for human blood pressure measurement", "Preparation and characterization of sputtered smart nanomaterials for electrochemic devices", "Inkjet printing of conducting polymers for optoelectronic devices-processability and wetting characteristics".

Waste utilization, recycling and Management

The progress of the project entitled "Utilization of Rice Husk-An Agricultural Waste for the Development of Useful Silicon Based Monoxide Ceramics" was reviewed during the year.

Flux Enhancement and Fouling Reduction During Effluent (Leather and Dye) Treatment using Membrane Separation

Experimental Set-up

The effluent from each of the separation units (namely, soaking, liming, deliming-bating, pickling, degreasing, tanning, neutralization, dyeing and fatliquoring effluent) were individually treated, preceded by an optimized pretreatment method for each of these effluent. The separation scheme, e.g., the types of membrane separation operations (reverse osmosis, nanofiltration, ultrafiltration) to be used for each effluent, their operating conditions, etc. were optimized through experiments and the effluent qualities (in terms of BOD, COD, salt, specific inorganic components) measured. The developed separation schemes and methods successfully removed spent chemicals and salts, including chromium from the tanning effluent. The BOD and COD values of the treated effluent were well below the stipulated limits. The treated water was found to be suitable for recycling as feed and/or wash water. The sludge obtained from the specific pre-treatment processes were analyzed and found to have fertilizer qualities comparable to organic fertilizers.

To reduce fouling and enhance flux, strategically placed turbulence promoters were utilized in the flow path to lessen the formation of any deposited layer on the membrane surfaces. The optical microscopy assisted method developed for direct measurement of the deposition thickness on the membrane surface, coupled with the turbulence promoter experiments established the best promoter shapes for maximum flux enhancement. It was observed that curved turbulent promoters could increase the flux significantly (as high as 60%) compared to laminar flow, without increasing pumping cost in a significant way. For example, increases in flux using turbulent promoter were 31-57% in nanofiltration, 43% in reverse osmosis for tanning and 50% in ultrafiltration for the pickling effluent.

Biodegradable/Bio-medical Polymers

Department has mobilized few project proposals to catalyze research and technology development in this area. The progress of following projects was reviewed during the year:

- Development of degradable composites with Euphorbia latex and natural fiber
- Development and Scale-up of Stable Environment Friendly, Water-based Microemulsion Formulations of Neem Based Pesticides

- Development of novel sun protection agents based on new macrocyclic metacyclophanes.
- Technology Development of biodegradable additives and performance evaluation of biodegradable with various plastics.
- Engineered Biofiber hybrid composites: opportunities & challenges for environmental sustainability & high performance applications**.**

Ceramic Technology Upgradation Programme

The project entitled "Developmental aspects of double fired wall tiles by suitable substitution of various ceramic wastes for its gainful utilization" was initiated in addition to 7 other projects reviewed during the year.

Development of Microwave based systems

The progress of the project entitled "Design & Development of 42 GHz, 200 kW/CW/Long Pulse Gyrotron" was reviewed during the year.

Development of High Power Microwave System for Tea Processing

DST has initiated a project on new application of tea drying/ processing using high-end technology involving high power microwaves. The microwave system developed for tea processing can also be used for killing fungus/ bacteria developed on stored tea before packing. This will improve the quality and increase the shelf life of tea. The machine could also be used for many other agro-based processes such as controlling the moisture level in food grains, drying of fruit powder, vegetable branching, etc.

Variable power 10 kW Microwave System developed for Tea Drying has successfully been installed at tea garden of M/s Koomtai Tea Estates, Assam

Platform technologies for a range of application

Nine projects funded on development of DNA Methylation Detection kit; Planner Optical Waveguides for use as Optical Sensors; Microelectrode arrays for electrochemical applications; Infrared spectroscopic study for tumor diagnosis; Electronic nose technology; Instrumentation for Bacterial Antibiogram; Capacitance and conductance based sensor Instrumentation for biochemical characterization; Parasite Detection Instrument using fluorascence and image processing; Novel free redical biosensor based on embedded system; were initiated .

Miscellaneous Technologies

New projects on Development of an automated system for differentiating slowly and rapidly evolving human genes to facilitate medical research ; Software infrastructure and programming model to enhance the performance of application on multi core platform; Realization of IP based wireless sensor network with emphasis on image transfer and on-demand routing were initiated during the year. One of the major technologies based on Carbon Carbon aerogel based super capacitor for button cell applications developed. Key accomplishments were made in three steps for the fabrication of button cells using Carbon Aerogel.

Carbon aerogel is a special class of open-cell monolithic forms of carbon, which possess interconnected structure with considerable high surface area and tunable pore-sizes. Carbon aerogels of different compositions were prepared and fabricated under this project. The key accomplishments were made in three steps for the fabrication of button cells using Carbon Aerogel which are given below:

Preparation of Carbon aerogel

Carbon aerogels of varying compositions were prepared from precursor organic gels followed by supercritical drying and pyrolysis in inert atmosphere. The specification of the RF and carbon aerogel and their physical properties are as follows:

Properties	RF Aerogel	Carbon Aerogel
Bulk density (g/cc)	0.15 – 0.60	0.20 – 1.00
BET surface area (m^2/g)	200 – 500	300 – 1200
Av. pore size (nm)	10 – 30	3 – 10
Pore volume (cc/g)	0.63 – 1.50	0.27 – 1.30

Preparation of Carbon aerogel Electrodes

Carbon aerogel based electrodes of thickness 80-250 μm and width 10-50 mm were prepared by calendaring technique using as-prepared carbon aerogels powders and organic binder (PTFE) of different weight percentage (6-12 wt%). Green tapes were then dried at 120°C for several hours and followed by curing at 250-350°C for 2 hours under nitrogen atmosphere

Fabrication of Carbon aerogel Super-capacitors

Carbon aerogel super-capacitors of capacitance 0.25 to 1.20 F exhibited good stability (±10% tolerance only) were fabricated using two carbon aerogel based electrodes in combination of current collector electrode (thin Ag-foil, 50 μm thick), porous membrane and electrolyte (Et_4NBF_4) in organic medium (Propylene carbonate). Fabricated super-capacitors were tested using indigenously fabricated Farad meter and Super-capacitor testing system (SCTS).

WATER TECHNOLOGY INITIATIVE PROGRAMME

The Water Technology Initiative (WTI) progamme of DST has focused on creation of databases, assessment and evaluation of technologies for Safe Drinking Water for decentralized applications. Various systems and solutions available for providing safe drinking water for domestic application are being assessed and evaluated under different social contexts. The scheme also aims to initiate path-breaking research which will lead to technologies of future that are currently at a nascent stage to address water related challenges facing the country. Attempt is being made to overcome the risk factors by developing focused inter-disciplinary programme to create a "*shelf of technological solutions*" synergizing complementary strengths of various institutions.

The focus of the programme is on development and proving convergent technology solutions under real-life conditions. A database would be developed to recognize and rank technologies for decentralized application in purification of drinking water.

During the year, the thrust of the programme has been on design and development of low cost solutions for domestic use of technologies for ensuring safe drinking water quality. Accordingly, focus has been on filtration and adsorption technologies for development and demonstration. The activities also covered pilot testing of credible number of products and referencing of selected technologies to the social context of the application region. The specific achievements related to technology options for stand-alone drinking water purification systems for rural schools, field assessment of technological solutions for arsenic, fluoride, iron and desalination of brackish water as well as sea water, scientific evaluation of various indigenously developed water purification technologies in academic institution, laboratories, etc. Specific achievements are highlighted here:

1. Research and Development Projects:

The important R&D projects supported during the year included studies on Carbon membranes for drinking water treatment, fly-ash membranes for waste water treatment and bio-monitoring of pathogens in water.

2. Demonstration, Upscaling and Replication:

A two stage reverse osmosis system of 6000 lph capacity for seawater desalination with provision for energy recovery was initiated. Development of instrumentation for remote monitoring of performance of water purification plants was also supported. Demonstration of high efficiency solar stills and household defluoridation system in various parts of Rajasthan was also supported. Towns and cities located by rivers in Uttarakhand directly abstract surface water for drinking, which is contaminated due to discharge of untreated sewage, presence of pathogens and turbidity. In order to address this problem, technology demonstration of bank filtration as a pretreatment step to remove pathogens and organics was supported in 5 locations.

Replication of cost effective user friendly system for arsenic removal based on locally available zerovalent iron was initiated in 50 affected sites across 5 States in the country. The system consistently delivers arsenic- free drinking water conforming to specification and generates minimal sludge.

Arsenic Removal Unit in West Bengal

Field model for Arsenic Removal Unit (ARU) was developed based on co-precipitation, pre –filtration, adsorption, post –filtration in series by School of Water Resources Engineering (SWRE), Jadavpur University. One hand-pump attached ARU has been installed at Village Malatipur, Bilbora-Kobra Gram Panchayat, J L No.-5 Lalgola Block, District., Murshidabad. The functioning of the unit has been monitored and found to be producing Arsenic-safe water conforming to BIS- standard.

Community Based Arsenic Removal Plant at Maltipur

Two Stage Reverse Osmosis System

1. Scouting of Technologies

In order to identify various drinking water purification technologies available in the country and assess their status of development/ commercialization, a study was conducted which covered 204 manufacturing organizations, 10 R&D labs and 40 community users like water supplying agencies, Panchayati Raj Institutions, public health engineering departments. The report has provided a technology based classification of various drinking water purification technologies for community applications and their status of development. An inventory of technology solutions for addressing various contaminants has also been prepared as part of the study.

2. Evaluation of Technologies

Evaluation of stand-alone water purification system was carried out in 20 States (20 schools in each states) based on scientifically developed protocol in association with the concerned State S&T Councils. Field evaluation of various technologies for removal of fluoride and bacteriological impurities was also initiated.

3. Capacity Development

Trainers' Training Programme on 'Sustainable Rainwater Harvesting and Ground Water Recharge in Developing Countries- HRD and Technology Transfer' was organized by DST in collaboration with NAM S&T Centre and Karnataka State Council for Science and Technology, during 22 - 27 February, 2010 at Bangaluru. 17 participants from 16 NAM countries including Pakistan, Nepal, Sri Lanka, Myanmar, Zambia, Egypt, Iran etc. and 9 Indian participants from 5 States (Punjab, Uttarakhand, Karnataka, Tamilnadu and Maharashtra) participated in the event. The training programme involves rainwater harvesting, groundwater recharge from buildings, apartments, office complexes, corporate sectors, companies and various institutes.

SOLAR ENERGY RESEARCH INITIATIVE

DST under Solar Energy Research Initiative (SERI) supports activities aimed at improving efficiency of materials, devices, systems and sub-systems including innovative R&D demonstration projects. The programme also facilitates and encourages inter-institutional linkages to develop state-of-the-art products and development of critical mass of R&D strengths for Solar Energy Research.

The focus of the programme is on Research, Development and Demonstration activities to promote utilization of novel Solar Energy Systems. Applications of Solar Energy for applications other than power generation are being explored and assessed of their potential to provide convergent technology solutions under real-life conditions. The programme also demonstrates hybrid solar power systems integrated on various R&D pathways and multiple technology alternatives for distributed energy use to validate their viability to meet rural energy needs under public private-partnership mode.

During the year, mobilization effort in terms of a national initiative was mounted by developing a knowledge network among the elite institutions in the country. Five rounds of interaction were held to formulate PAN-IIT initiative. This has led to identification of specific areas in which each IIT would be able to contribute in developing a vertically integrated solar energy system for the generation and delivery of a 1 MWe power, 8 hours a day, based on photovoltaic as well as solar thermal route. The PAN-IIT initiative is focused on developing national core competence in developing indigenous research-led cost-parity of solar energy options with fossil fuel based energy systems within the next two Plan periods.

Process has also been initiated to develop a solution for off-grid application with a target of providing power to a village at the cost of less than Rs.9 per Kwh of delivered power. As an initial step in this direction, Department has supported a 256kW Solar Thermal Technology Demonstration Project at village Shive, Pune. The plant is being set up with the technical expertise of M/s Thermax Ltd. The plant would operate with solar energy and would have biomass boiler as backup during the non- insolation period. The project is primarily based on indigenously developed design and manufacturing capabilities. The demonstration plant based on the parabolic troughs will be commissioned in 18 months under the public private partnership (PPP) mode. The success of this technology has potential for its multiplication in numbers both in centralized and distributed generation systems.

A "National Status Document and Aspirational Document" outlining 'Grand Challenges on Solar Energy' is also under preparation.

Parabolic Trough

Model of 256 kW Solar Thermal Hybrid Plan Proposed at Shive Village

INSTRUMENTATION DEVELOPMENT PROGRAMME (IDP)

DST has been promoting the area of instrumentation through its Instrumentation Development Programme (IDP) with the objective of strengthening indigenous capability for research, design and development of instruments in the country leading to their indigenous development and production, continuous updating of the technology to keep pace with technological improvements taking place globally. The industry collaborated projects are supported under the following thrust areas: Analytical & Optical Instrumentation; Sensor & Allied Instrumentation ; Industrial Instrumentation; Medical & Healthcare Instrumentation.

During the year the following activities were carried out:

New programmes/ projects initiated

Some of the industry collaborated new programmes/ projects initiated recently included:

Development of Integrated Electronic Nose and Vision System for quality estimation of Basmati Rice initiated at Center for Development of Advanced Computing (C-DAC), Kolkata.

Development of a Hydrogen gas sensor with high sensitivity and selectivity based upon nano-crystalline nano-porous metal/ metal oxide for space exploration in heavy water plant industry initiated at Indian Institute of Chemical Technology (IICT), Hyderabad.

Establishment of Sensor Hub at Central Glass and Ceramic Research Institute (CGCRI), Kolkata.

Design, development and characterization of magneto-optic material based current sensor for industrial application at Birla Institute of Technology (BIT), Mesra, Ranchi.

Know How/Technologies Transferred

Technology of On-Line Mango Sorting System using Soft X-Ray Imaging designed and developed by Chennai Centre of Central Electronics Engineering Research Institute (CEERI) was transferred to M/s Proteck Circuits & Systems Pvt. Ltd., Chennai. The system uses soft x-ray imaging to detect spongy tissue or seed weevil infestations which are not visible externally and is useful for exporters involved in exporting bulk quantities of exotic mango varieties such as Alphonso Mango.

Instruments under Development

Infant Ventilator

A project to design and develop an Infant Ventilator using electro-pneumatic system is being implemented by PSG College of Technology, Coimbatore. The developed instrument will provide an accurate control of air/ oxygen mixtures capable of operating in volume, time or pressure cycles with a built-in modular design. The proposed Infant Ventilator will have Respiratory Rate of 1 to 150 bpm with inspiratory time of 0.10 to 3.00 seconds. Also, the inspiratory pressure will be 5 to 70 cm H_2O and expiratory pressure of 0 to 30 cm H_2O. The Infant Ventilator will consist of breathing system monitor, exhalation valve, frequency blender, ventilator development kit and TFT display controller with user interface. Till date, various sensors to be used in the development of Infant Ventilator have been calibrated and exhalation valve and frequency blender have been fabricated and tested. Breathing System Monitor, Ventilator Development Kit, Adjustable Pressure Regulator and TFT Display Controller with user interface are being developed. After the development of the different modules, the 3 prototype ventilators will be fabricated and tested and field trials at different Medical Hospitals will be conducted.

Breathing System Monitor Test Set-Up at PSG College of Technology, Coimbatore

Design & Development of Controlled Melting & Freezing System for Preparation of Ultra-Pure Crystalline Material

A project for design & development of Controlled Melting & Freezing System for Preparation of Ultra-Pure Crystalline Material is being undertaken by Centre for Materials for Electronics Technology (C-MET), Hyderabad and Department of Instrumentation, Indian Institute of Science (IISc.), Bangalore. The project is aimed at development of Controlled Melting & Freezing System suitable for preparation of Ultra-Pure Crystalline Material such as Gallium-Indium (GaIn), Gallium Antimonide (GaSb), Gallium Telluride (GaTe), Indium Antimonide (InSb) and Gallium Indium Antimonide (GaInSb) from 4N+/5N to 6N+/7N purity.

Two prototype/ laboratory furnaces (750° C & 1000° C) and sample lowering facility have been developed and the parameters are being optimized by preparing high purity GaTe, GaSb, InSb, GaIn and Bi crystalline samples. The characterization of these samples is in progress in both the project implementing laboratories. Perfection of the process parameters will be taken up based on the feedback of purity tests/ characterization results.

Novel Plasma Reactor for production of Nano Alumina at Dalmia Institute of Scientific and Industrial Research, Rajgangpur, Orissa

A novel Plasma Reactor is under development for production of Nano Alumia which can be used in refractories.

Human Pulse Detection and Analysis System for Diagnosis by Ayurvedic Way at Pune University, Pune

The instrument under development contains mechanical fixture to fix three piezoelectric sensors having the same characteristics on the arm of the patient by providing the movement in three dimensions. The model is designed in such a way that we can get minimum centre to centre distance between left and right

arm sensor i.e. 25 mm and maximum centre to centre distance between left and right arm sensor i.e. 40 mm. and total weight of the instrument is around 1.8 Kg. This instrument basically imitates the process which is used by the Ayurvedic Physician for the diagnosis of the nature of the person as depicted in the ayurveda *viz*. *Vata, Pitta and Kapha*.

Fluorescence based biosensor for detection of iron at North Maharashtra University, Jalgaon

The technique for the detection and quantification of iron in clinical blood, water, soil, and other environmental samples has been developed. The patent application for detection of Siderophore using dry paper strip is under preparation of filing.

Near Infrared Spectroscopy based online instrument for quality assessment in Edible Oil Industry jointly at Central Food and Technological Research Institute, Mysore & Central Electronics Engineering Research Institute, Chennai Centre, Chennai

The above project aims at development of relationship between NIRS and peroxide value, free fatty acids and marker compound composition using chemometric techniques. The developed system is being integrated online for monitoring the peroxide value and free fatty acid in selected edibles oils in the industry.

Continuous feed equipment for extraction of Aloe Vera Gel at Central Institute of Agricultural Engineering, Regional Centre, Industrial Extension Project, Tamil Nadu Agricultural University, Coimbatore

The main feature of the equipment under development is to remove the central gel of Aloe vera leaves with little contamination of the Aloin. The equipment helps in extracting the gel from Aloe vera leaves without contaminating the gel with toxic juices which are indigenous to the rind of the leaves. The process of cutting of leaves, rind panel peeling and gel removing operations is carried out during continuous movement of the leaf along the developed system. The instrument will also reduce the processing time and human drudgery involvement in the process. The instrument is suited for small and medium scale Aloe vera processing units. The output capacity is likely to be about 50 Kg gel per hour which means 200 kg of Aloe vera to be processed per hour. This will also replace the traditional hand held Aloe vera processing.

Workshops/ Symposia/ Meetings and Training/ Skill Development Programmes

Some of the Workshops/ Symposia/ Meetings and Training/ Skill Development programmes organized during the year included the following:

Investor-investigator meet on Instrumentation Development held during 26-27 July 2009 at SD College, Ambala in association with Instrument Design Development and Facilities Centre (IDDC), Ambala and Ambala Scientific Instruments Manufacturers Association (ASIMA), Ambala.

Training programmes on repair and maintenance of Biomedical Instruments.

A national workshop on "Capacity Building of Technical Personnel for Industrial Clusters in Northern India" oraganized in collaboration with National Research and Technological Consortium, Parwanoo, Himachal Pradesh.

A training programme on production techniques for fabrication of optical components for optical/ scientific instruments (lens & prism making) by Instrument Design Development & Facilities Centre (IDDC), Haryana State Electronics Development Corporation Ltd., (HARTRON), Ambala.

Investor-investigator meet on Textile Instrumentation held at South India Textile Research Association (SITRA), Coimbatore, on 5 December 2009.

A cluster of projects meeting on Analytical/ Sensors/ Industrial/ Biomedical Instrumentation held at Bengal Engineering and Science University (BESU), Howrah during 1-2 February 2010.

New Initiative

To involve scientists/ technologists from all parts of the country in Instrumentation Development Programme (IDP), theme based discussions/ interaction meetings involving experts, researchers and industry representatives were initiated. In these meetings, the potential PIs present their concept proposals for development of instruments on the theme of the meeting and projects are evolved for consideration.

DRUGS AND PHARMACEUTICALS RESEARCH PROGRAMME

The Drugs and Pharmaceuticals Research Programme (DPRP) was initiated in 1994-95 for promoting Industry–Institutional collaboration in drug and pharmaceuticals sector. This programme aims at enhancing capabilities of institutions and Indian Drugs & Pharmaceuticals Industry towards development of New Drugs in all systems of medicine. The specific objectives of this scheme are:

- To synergize the strengths of publicly funded R&D institutions and Indian Pharmaceutical Industry in developing drugs in areas of national relevance;
- To create an enabling infrastructure, mechanisms and linkages to facilitate new drug development; and
- To stimulate skill development of human resources in R&D for drugs and pharmaceuticals.

Achievements

The following are the new collaborative R&D projects which have been funded during the year:

- Expressing of an epignetically silenced tumor suppressor gene, RASSFIA in human cancer cells by Mahanine: A lesion from human prostate cancer cell study and a promise for human cancer treatment between Visva Bharati, Santiniketan and East India Pharmaceuticals Works Ltd., Kolkata.
- Anti aging and Anti wrinkle formulation with matrix metalloproteinase inhibitory activity from natural resources between Jadavpur University, Kolkata and Parker Robinson (P) Ltd., Kolkata.
- Rabies DNA Vaccine: Bioprocess optimization & immunogenecity studies between JNU, New Delhi and Parenteral Biotech Ltd., Noida.
- Optimization of a recombinant R-Phenylacetyl Carbinol (R-PAC) production process between Indian Institute of Technology (IIT), Mumbai and M/s. Embio Ltd., Mumbai.
- Scale up and optimization of a mammalian cell culture system for the over expression of therapeutic monoclonal antibodies with specific reference to Rituximap between JNU, New Delhi and ARA Healthcare Pvt. Ltd., Gurgaon.
- Development of anti-microbial agents from soil microflora among CDRI, Lucknow; IMTECH, Chandigarh; SRISTI, Ahmedabad; Karnataka Antibiotics & Pharmaceuticals Ltd, Bangalore.

The Pharma Industry Loan R&D projects

- Chiral technologies for single enantiomer drugs/drug intermediates through biocatalysis to M/s. Unimark Remedies Ltd., Mumbai.
- WCK 2349 oral anti-MRSA NCE clinical development – Phase I Single Escalated Dose and Multiple Escalated Dose studies to M/s. Wockhardt Ltd., Mumbai.
- Sun-1334H – A novel selective H1 receptor antagonist for allergic disorders to M/s. Sun Pharma Advanced Research Company Ltd., Mumbai.
- ZYH1 Phase III Clinical studies in dyslipidemia with type 2 diabetes mellitus, hyper-triglyceridemia with type II diabetes not controlled with Atorvastatin Therapy, Hypertriglyceridemia in HIV associated lipodystrophy and non-alcoholic seatohepatitis to M/s. Cadila Healthcare Ahmedabad.
- Establishment of state-of-the-art toxicology research facility for large animals (Beagle Dogs) to M/s. Sipra Labs. Ltd., Hyderabad.
- Development of Ayurvedic Formulation for the prevention and management of Allergic Diseases to M/s. Baijnath Pharmaceuticals Pvt. Ltd., Kangra.
- Development of a novel, highly efficient and cost effective process to produce large quantities of iso-sulphan blue an active pharmaceuticals ingredient used as a contrast agent for the delineation of lymphatic vessels and particularly useful as a cancer diagnostic agent to M/s. Innovassynth Technologies (I) Ltd., Mumbai.
- Enantioselective synthesis of the drug Pregabalin to M/s. Helvetica Industries (P) Ltd., New Delhi.

National Facility supported

- Strengthening of existing facilities with a special emphasis to bioequivalence study of drugs and metabolites in plasma by LC-MS/MS at Jadavpur University, Kolkata.

Interaction Meets, Conferences & Workshops

Support was provided for organizing several interaction meets between Academia and Industries involved in R&D and products development in Natural Products and Modern System of medicine. These are as follows:

- International Conference on "Drug Development and Discovery" – Public Private Partnership by South Asian Chapter of American College of Clinical Pharmacology (ACCP), KEM Hospital, Mumbai, in collaboration with Maharashtra University of Health Sciences, Nasik during 3 - 4 October 2009.
- Pre-conference workshop on "Good Practices in Clinical Research" and International Conference on "Drug Discovery to Clinical Development" during 8-10 December 2009 at Mumbai by Institute of Clinical Research (India) (ICRI), New Delhi.
- National Conference on "Recent Trends and Applications of Nanotechnology in Pharmacy and Biology" on 21-22 January 2010 by Anna University, Tiruchirappalli.
- 4th International Symposium on "Current Trends in Drug Discovery Research" during 17-21 February 2010 at Central Drug Research Institute, Lucknow.

SCIENCE AND TECHNOLOGY ADVISORY COMMITTEE

Science And Technology Advisory Committee (STAC) and the nodal role of DST came into being from the recommendations of Planning Commission Seminar on New Technologies held in 1986. The Department of Science and Technology has played a catalytic role in initiating the STAC mechanism in 24 socio-economic ministries.

Joint Technology Projects under STAC/IS-STAC:

In Phase III of the National Helium Conservation Programme, the 2nd and 3rd Helium / Geochemical Monitoring Laboratories were set up in J&K and Andaman & Nicobar Islands. The data collected is being further analyzed along with the data available with the central laboratory at Bakreshwar (WB).

National Program on Carbon Sequestration (NPCS) Research

(i) Under the project to develop technology for ***carbon recycling through conversion of CO2 into multiple alternate fuels,*** a prototype plant has been indigenously designed, developed, and commissioned at ***Rajeev Gandhi Prodiyogiki Vishwavidyalaya, Bhopal.*** Work on design/ fabrication of converters, and development of catalysts for conversion of captured CO^2 in to useful fuel molecules has been completed. A bio-reactor for production of bio-diesel from algae has also been designed and installed. Modeling, simulation of the processes, and further studies are in progress. (Fig.1)

Following are some results from simulation studies of CO^2 sequestration potential of agro forestry system under irrigated and rain fed conditions, in progress at National Centre for Agro-forestry, Jhansi:

Changes in biomass, soil organic carbon, carbon sequestered and CO^2 equivalent carbon sequestered were estimated using CO^2 fix (CO^2FIXV3.1) model. Simulation period for each system adapted as per rotation cycle of individual tree species.

Dalbergia sissoo based agrisilviculture system - simulation done for 45-year periods (1994-2038) - results (Fig. 1)

Albizia procera based agrisilviculture system - simulation done for 30-year periods (2000-2030) – results (Fig. 2)

H*ardwickia binnata based agrisilviculture system* - simulation done for 40-year period – results (Fig. 3)

Emblica officinalis based agrisilviculture system - simulation was done for 25-year period – results (Fig. 4)

Under the project "Carbon Sequestration by higher plants and algae at elevated carbon dioxide" being implemented jointly by JNU and Delhi University the following are the highlights/achievements so far:

Results demonstrated that in addition to decreased gene and protein expression, down regulation of photo-synthesis in temperature-stressed plants is caused by reduced post-translational import of plastidic proteins required for the replacement of impaired proteins coded by nuclear genome. As compared to those grown in ambient CO^2, mustard (*Barrisca)* plants grown inside the FACE rings in elevated CO^2 (600 ppm) had higher bio-mass (55%).The plant height increased by 17% and the root length increased by 21%. Numbers of leaves per plant increased by 44% and root and shoot diameter increased by 47%.

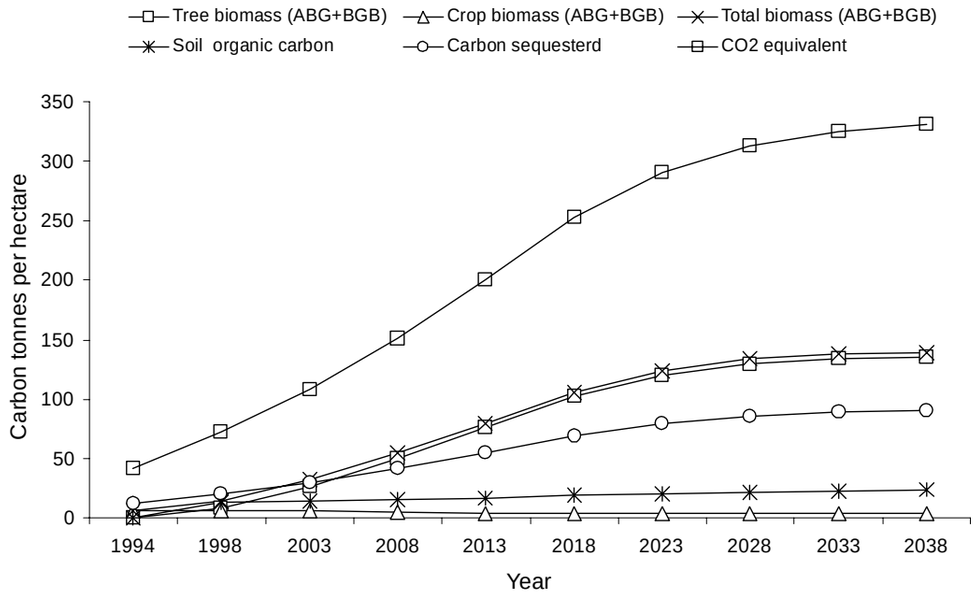


Fig. 1: *Dalbergia sissoo* based agrisilviculture system

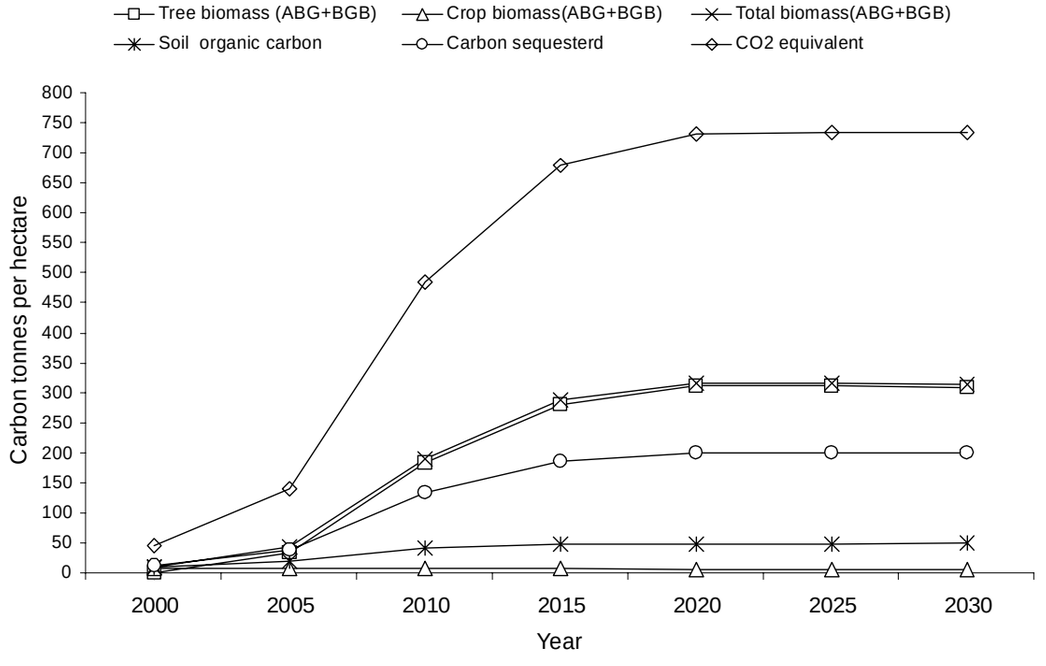


Fig. 2: *Albizia procera* based agriculture system

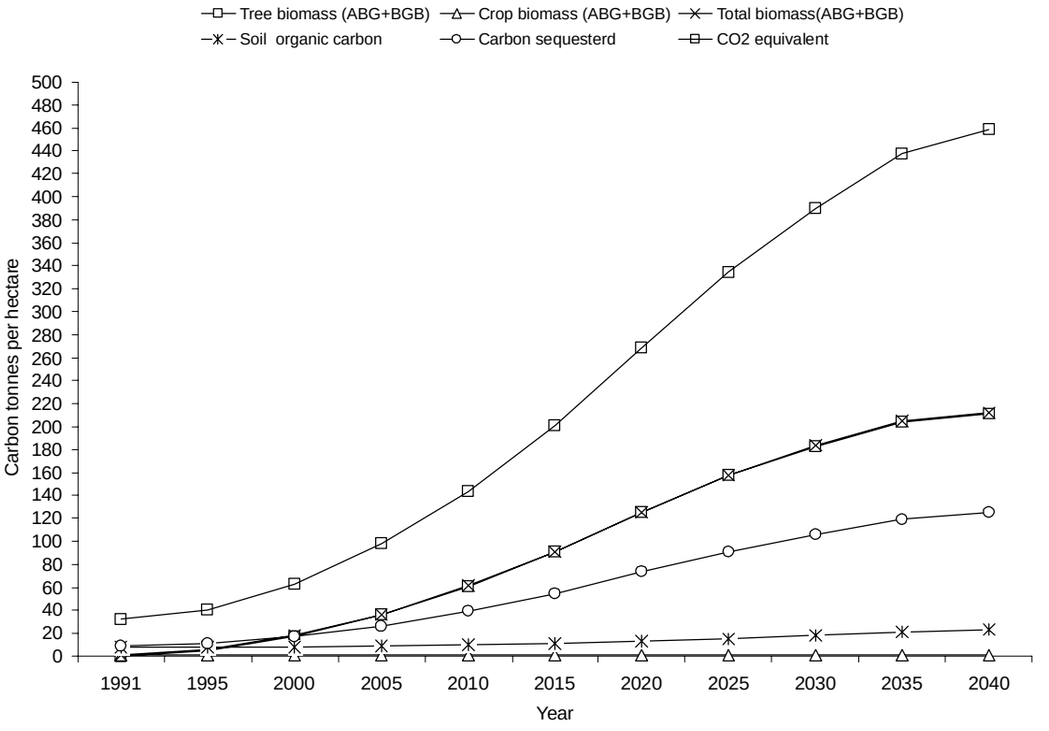


Fig. 3: *Hardwickia binnata* based agrisilviculture system.

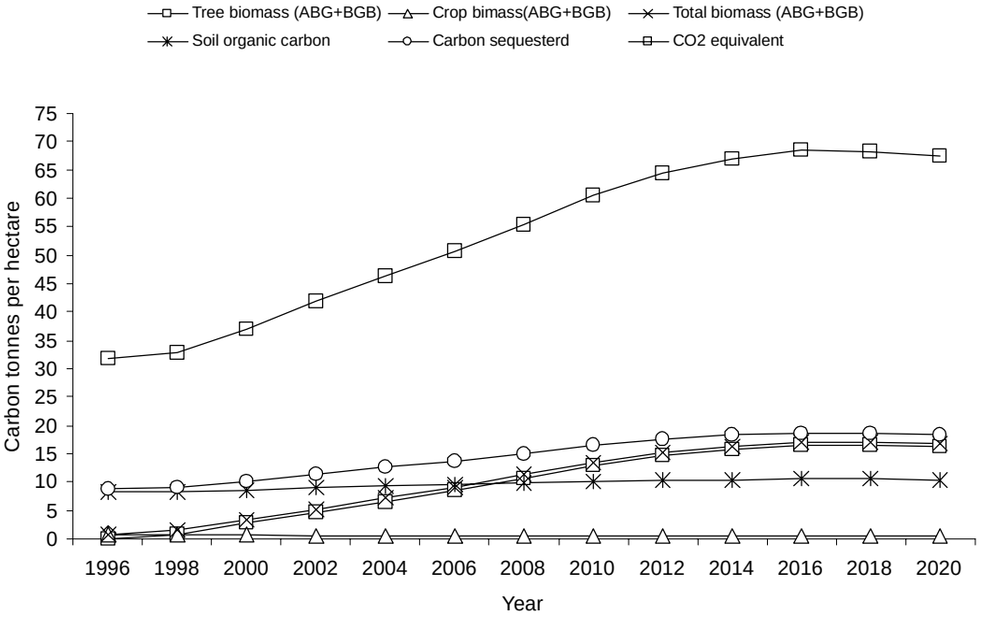


Fig. 4: *Emblica officinalis* based agrisilviculture system

Under the project "Sequestration of Carbon di-oxide into geological environment- Lab studies" by NGRI, Hyderabad, the following were important results:

Lab. Experiments to establish the chemical reactivity of the picritic basalts from DVP were conducted at approx. 100 deg C and CO^2 pressure of about 60 bars. Indigenously fabricated Titanium vessels, having an internal volume of approx. 25 g picritic basalt chips of approx. 2–3 mm size were reacted with CO^2 gas and 25 wt% of H^2O for about 5 months duration

The whitish cluster of crystals (softer in nature) were grown over the picritic basalt chips were carefully separated and aanalyzed by Fourier Transform Infrared (FTIR) spectroscopy. FTIR studies were carried out on a Thermo-Nicolet make NEXUS FTIR Spectrometer (with sealed and desiccated optics) using a thermo electrically cooled Deuterated Tri-glycene Sulphate (DTGS) detector, extended range KBr (XT-KBr) beam splitter, and a dual source working in the wave number range 375-12500 cm^{-1}. The conventional KBr pellet method was followed to study the fundamental modes in the wave number range 400-4000 cm^{-1}, using NEXUS Ever-Glo Source.

Program Advisory & Monitoring Committee (PAMC) met on 4-5 May 2009 in which progress of 16 ongoing projects was reviewed, and following two new projects were approved:

(a) Carbon Sequestration Potential in Wetlands of Vedaraniam, South East Cost of India – Bharthidasan University, Tiruchirapalli, TN

(b) Carbon Sequestration through Aforestation for Mitigating CO^2 emission from Thermal Power Station – National Afforestation & Eco-Development Board, Jadavpur University, Kolkata

PROBE-Pilot Program

Under PROBE-Orissa 3 Technical Resource Centers (TRCs) completed their projects successfully which were sanctioned to them in 2006 thereby setting up of network of Met. laboratories in 60 schools. The other on going TRCs (10) which were set up during 2007-2008 and 2008-2009 also established a further network of Met. labs in 100 schools. During the year 2009-2010, 13 new TRCs (including 1 each in TN & AP) were set up bringing yet another 150 schools under coverage of PROBE-Orissa program. Teachers training workshops were organized for 150 teachers of the concerned schools under different TRCs.

Under PROBE-Uttarakhand, six projects were completed, thus establishing a network of Met. labs. In 101 schools in 13 districts of Uttarakhand State. During the course of the program 90 teachers were trained through 3 Master Trainers Workshop organized at IIT, Delhi.

Under PROBE-NCR 3 TRCs (including 1 TRC in WB) competed their projects successfully, thus setting up a network of Met. labs in 30 schools of NCR, Delhi. 2 Teachers Training workshops were organized. In one of the project implemented by IIT, Delhi the surface parameters recorded by schools were utilized to demonstrate that assimilation of such high resolution data in a regional (meso-scale) model can enhance the quality of forecasts in the time range of 12-24 hrs.

Program Advisory and Monitoring Committee (PAMC) on PROBE program met on 22-23 October 2009 to review the progress of 26 Technical Resource Centers (TRCs) established under PROBE-NCR, TN, WB and Orissa

Interaction with other Ministries

The Department of science and Technology has played a catalytic role in initiating the STAC mechanism in 24 socio-economic ministries. The Inter-Sectoral Science & Technology Advisory Committee (IS-STAC) was set up under the Chairmanship of Secretary, DST to provide a forum for the Member Secretaries of STACs, other scientists and technologists to share the expertise and experience and provide additional tools in the decision making process vis-à-vis socio-economic development. In this context, IS-STAC secretariat participated in various meetings of STACs and provided its inputs pertaining to the various R&D proposals approved during these meetings held during 2009-2010 as given below:

Ministry of Mines

(i) 39th Meeting of Standing Scientific Advisory Group (SSAG) was held on 5 October 2009 under the chairmanship of Secretary, Mines. IS-STAC secretariat participated in these meetings. In this meeting two new projects were approved for joint financial support of DST and Min. of Mines.

IS-STAC also participated in two Project Evaluation & Review Committee (PERC) meetings held.

Min. of Mines constituted a Task Force for Preparation of Road Map (2010-2015) for Jawaharlal Nehru Aluminium Research, Development & Demonstration (JNARDCC), Nagpur (an autonomous body under Ministry of Mines), with the aim to achieve self sustainability by JNARDDC, Nagpur. This task Force convened 3 meetings in which and a document on Road Map was finalized and signed for submission to Secretary, Mines for approval. IS-STAC secretariat participated in the Governing Body Meeting of JNARDDC, Nagpur held on 19 October 2009

Ministry of Coal

IS-STAC secretariat participated in 44th meeting of Standing Scientific Research Committee (SSRC) held on 11 November 2009.

IS-STAC secretariat participated in the two meetings of Technical Sub Committee under SSRC held on 29 January 2010.

Ministry of Steel

IS-STAC secretariat participated in the Empowered Committee (EC) meeting held on 20 September 2009

IS-STAC secretariat participated in the meetings Evaluation Group of EC held on 14 August 2009 and 3 October 2009

Member Secretary (IS-STAC) attended the meeting of Empowered Board on joint technology project "Steel Technology Center at IIT, Kharagpur" held in September 2009 and review committee meeting of the project being implemented by Jadavpur University, Kolkata on 22 February 2010

Ministry of Environment and Forests

IS-STAC secretariat attended the NCDMA meetings held on 22 September 2009 and 11 March 2010

Ministry of Communication and Information Technology

Department of Information Technology re-constituted its Working Group on "Electronics Materials & Components" on 04.01.2010. Member Secretary (IS-STAC) & Head (STAC) have been nominated as members on this working group. Member Secretary (IS-STAC) attended the meeting of the working group held on 10 March 2010 at New Delhi.

Ministry of Defense/Defense Research & Development Organization (DRDO)

Member Secretary (IS-STAC) was nominated to attend the 7th meeting of Board for Smart Materials Research and Technology (B-SMART) held on 12 March 2010 at Bangalore. This has been constituted under National Programme on Micro and Smart Systems being coordinated by Aeronautical Development Agency (ADA), Bangalore.

TECHNOLOGY DEVELOPMENT BOARD

Government of India constituted Technology Development Board (TDB) on 1st September 1996, as per the provisions of the Technology Development Board Act, 1995 and the operation of the fund was assigned to the Department of Science & Tehcnology, Ministry of Science & Technology Government of India.

The mandate of the Technology Development Board (TDB) is to provide financial assistance to the industrial concerns and other agencies attempting development & commercial application of indigenous technology or adapting imported technology for wider domestic application. The financial assistance from TDB is available in the form of loan or equity and/or in very exceptional cases, it may be grant. The loan assistance is provided up to 50 percent of expenditure to be incurred out of the approved project cost and carries 5 percent simple rate of interest per annum. TDB may also subscribe by way of equity capital in a company, subject to maximum 25 percent of the approved project cost. The financial assistance is provided during the commencement, start up or growth stages of an industrial concern. The website of TDB website is www.tdb.gov.in.

In addition to the direct support to industries for commercialization of indigenous technologies, TDB continued to network with technology focused Venture Capital Fund (VCF) to support technologically innovative viable ventures with the objective to spread itself by providing support to early stage ventures for SMEs having innovation and innovative products/services. TDB has decided to contribute in two venture capital funds for supporting technology oriented projects in SME sector.

TDB also took growth-oriented initiative and provided financial assistance to Technology Business Incubators (TBIs) and Science & Technology Entrepreneurs Parks (STEPs) under Seed Support System fro Start-ups in Incubators to incubate technological ideas. The assistance is positioned to create techno-entrepreneurs apart from acting as a bridge between development and commercialization of the technologies. The scheme has progressed well and is being continued. TDB has extended the scheme and supported 5 more incubatos during 2009-10 with grant assistance of Rs. 500 lakhs. Till now TDB has provided support to STPIs/TBIs with aggregate assistance of Rs. 15 crore. This scheme has benefited entrepreneurs from STEPs and Incubators in various fields.

During the year, TDB signed 18 agreements (including 5 with STEPs/TBIs for Seed Support) with commitment of Rs. 53.97 crore out of total project cost of Rs. 138.14 crores. TDB has disbursed Rs. 69.94 crore to the assisted companies for implementation of the projects. TDB's support covers most of

the sectors of economy namely, Health, Biotech, Chemical, Engineering, Agriculture, Energy & Waste Utilization, Telecommunication and Information Technology. The projects are spread throughout India covering funds, TDB has encouraged innovation besides stimulating formation of new funds that invest in companies based on advanced technology and in-house technological capability. During the peirod a sum of Rs. 5.17 crores has been disbursed to venture capital companies which had raised a capital outlay of more than Rs. 200 crores from multiple sources.

TDB has entered into a MOU with the Commonwealth Business Council (CBC), UK to collaborate on a reciprocal bases to further their objective of supporting SME growth via technology transfer, industrial research, technology development and innovation for the purpose of generating economic benefits for both India and U.K. The CBC has launched a programme in association with Indian and UK industry in the field of Clean Energy Technology Development. Other MoUs have been signed with Agence Nationale De Valorisation de la Recherche (ANVAR), France and with Center for the Development Industrial Technology (CDTI), Ministry of Industry, Tourism and Trade, Spain in the past.

Two bilateral projects were also approved under India Spain Innovating Program (ISIP) between CDTI, Spain and TDB to promote, assist and fund the development of joint technology cooperation/ tansfer projects and for supporting SME growth via technology transfer and innovation for the purpose of generating economic benefits to both the countries.

CHAPTER 3

INTERNATIONAL S & T COOPERATION

DST continued with the execution of its mandated responsibility of (i) Negotiating, concluding and implementing S&T Agreements between India and other countries at bilateral and regional levels; (ii) Providing interventions on S&T aspects of multilateral bodies. This responsibility was carried out by DST in close consultation on the Indian side with Ministry of External Affairs; Indian Missions Abroad; Science Counselors posted in Indian Missions located in USA, Germany, Japan, Russia; S&T related Ministries and Sectoral Ministries of Government of India; Indian Scientific Agencies and Indian Science and Engineering Academies. DST continued its engagement with Industrial & Engineering Associations/ Platforms in guiding initiatives to leverage international partnerships for joint research and technology development in domains of national priority.

Guiding Principles for International S&T Cooperation

India's S&T relations with other countries and international bodies were guided by the principles including:

- Leveraging international expertise in the form of joint project(s) based visits for (i) strengthening nationally important on-going research programs, (ii) accelerating institutional and human capacity building vital to India becoming a global player in knowledge based economy and (iii) reflecting on global practices relevant to technology and innovation based demands and infrastructural requirements;
- Co-investment of resources including funds for joint research projects and strategic joint initiatives involving research entities from industries;
- Absorbing experience of existing global research facilities in fine-tuning and/or coupling with upcoming or existing Indian research facilities
- India's proactive engagement in creation or addition to international advanced research facilities, as an expression of Indian maturity/ competencies;
- India's leadership in empowering developing countries in S&T;

Spectrum of Cooperative Actions undertaken

During the year, DST along with its counterpart agencies in other countries, regional bodies and international organizations, co-sponsored/ undertook a spectrum of cooperative actions such as: (i) Exploratory scientific and ministerial missions; (ii) Joint workshops; (iii) New bilateral mechanism for joint research and technology development with co-investment of resources including financial, for strategic partnerships of India with select countries ; (iv) Joint research projects; (v) Joint R&D centres; (vi) Networking of centres of excellence; (vii) Utilization of large scale research facilities abroad; (viii) Advanced training fellowships; (ix) Participation in international mega-science projects; (x) Attracting foreign scientists especially Scientists & Technologists of Indian Origin (STIO) abroad for joint projects with home country scientists; (xi) Contributions to international non-governmental scientific bodies that allow India to empower other

developing countries; (xii) Technology summit, industrial fairs, S&T exhibition; (xiii) Ministerial Science Conference; (xiv) Fielding talented Indian research scholars to International Meetings with Nobel Laureates, ICTP Scientific Events; and (xv) CV Raman fellowships for African researchers.

Salient New Activities

- New Inter-Governmental S&T Cooperation Agreements/ MoU/ Working Programmes were concluded by India with Finland, Austria, UK, South Africa, Georgia and Saudi Arabia.
- Joint S&T Committee meetings were held with Norway, South Africa, Austria, Finland, Japan, Taiwan, South Korea, UK, Australia, Israel, ASEAN, Germany and EU.
- Agreement for establishment of the Indo-US S&T Endowment Fund has been ratified.
- Indo-German S&T Centre Indo-German Science and Technology Centre (IGSTC) has been conceived which will provide links to research, academia and Industry and support flagship projects between India and Germany in the areas of common interest. Both governments have committed to contribute each • 2 Million per year initial from each side for 5 years. EFC has been approved and Cabinet's approval is under way.
- C V Raman Fellowships for African researchers were launched (1216 person - months every year).
- India-ASEAN S&T Development Fund has been created as a follow up of the announcement at India- ASEAN Summit held in December 2005. DST and MEA would be contributing each year Rs.2.00 Crore to promote innovation and technology alliances involving industries on both sides. The details of the activities to be supported have been worked out and the fund is expected to take off from April 2010.

Bilateral Research Projects

- Argentina: 15 joint R&D projects are supported.
- Australia: Under the "Targeted Allocation Category" of the India and Australia Strategic Research Fund Program, two Indo-Australian Projects have been approved. Under the "Competitive Category", seven Indo-Australian research projects have been supported in the areas of agricultural research, astronomy and astrophysics, microelectronic devices & materials, nanotechnology, renewable energy & marine sciences.
- Brazil: 12 joint projects, 7 exploratory visits, one joint workshop in the area of Molecular Physics were approved.
- Croatia: Presently 12 joint R&D projects are being implemented.
- European Union (EU): 4 India-EU Research Projects have been selected by India-EU Scientific Evaluators Panel for co-funding by DST and DG Research European Commission, in response to the 2009 India-EU Call for Proposal under the India-EU S&T Agreement framework. 6th India-EU S&T Steering Committee met in India under the Co-chairmanships of Secretary DST and DG (Research) EC.
- Germany: 35 Joint research projects supported. Four Indian Partner Institutes of MP Institutes (Germany) and 6 India-MPG Fellowships were awarded to Indian scientists with complete project

funding. An Indo-German Centre on Computer Science was established with joint funding from DST and MPG.

- Italy: 27 Indo-Italian Research Projects have been approved for co-funding (including Indian scientists access to Italian synchrotron facility– Elettra & Phase II of India- Trento Program for Advanced Scientific Research-ITPAR).
- Japan: Under DST-JST Cooperation, 14 ongoing projects have been funded and 4 new projects were identified under the strategic cooperation program on ICT. Under DST JSPS Cooperation, 40 projects are running successfully. 20 new projects were approved during the current FY. 3 Joint Workshops and one Asian Academic Seminar was organized. The KEK, Tsukuba handed over a Beamline in its Photon Factory to India for fabrication of the Experiment hutch.
- Mexico: 17 new joint R&D projects were supported.
- Netherlands: Two joint workshop was organized in India on biomedical devices and health research.
- Peru: The Program of Cooperation in S&T 2008-2010 between DST and CONCYTEC of Peru was signed.
- Portugal: 19 projects are on-going.
- Russia: 16th Session of the Indo-Russian Joint Council for implementation and coordination of the Integrated Long Term Programme (ILTP) of Cooperation in Science and Technology led by Prof. C N R Rao and Prof. Kadyshevskii, was held in Russia. 100 joint projects are under implementation Joint activities in the forms of bilateral workshops, visit of thematic and composite delegations, exploratory visits and project based exchange visits (about 200) are being supported.

  DST-RFBR Arrangement: About 40 joint R&D projects are being supported in collaboration with Russian Foundation for Basic Research.
- Republic of Korea (South Korea): The first Joint Call for projects was issued by India and Republic of Korea as a result of which 33 joint projects were received. Financial support to the approved projects was initiated during the year.
- South Africa: 14 new joint R&D projects and 12 ongoing projects were supported and two joint workshops were organized.
- Spain: 25 new projects were approved.
- Switzerland: Indo-Swiss Joint Research Programme launched to support joint research projects (in basic and applied sciences in Public Private Partnership mode) and Institutional Partnerships. Indian side is to match the Swiss funding of 2 Million Swiss Francs per year (approx. Rs. 8 crores per year). About 20 joint research projects have been supported, 20 research fellowships of Indian Ph.D. students were provided, 15 visits were supported for joint utilization of advanced facilities and Institutional partnership projects were supported.
- Taiwan: 12 Joint research projects were supported and two workshops organized.
- Thailand: 3 joint projects which completed the required documentation were sanctioned during the year under the India-Thailand S&T Cooperation programme.

- Tunisia: 12 new joint R&D projects were approved for implementation.
- UK: Under DST-UKIERI programme, 25 ongoing projects were supported.. Under India-UK Science Networking Program, 4 projects were approvexd.
- USA: Under DST-NSF program of cooperation about 80 ongoing projects were supported.
- Vietnam: 11 new Indo-Vietnamese are ongoing.
- STIO's Projects: Collaborative projects with Scientists & Technologists of Indian Origin Abroad Program (CP-STIO), started in 2006, provided for supporting 27 on-going project-based visit of STIOs into India projects. Up to 20 collaborative projects with STIOs are being funded during 2009-10.
- India-Brazil-South Africa Cooperation: Three joint training schools were organized, one each in India, brazil and South Africa in the area of nano-science and technology. More than 80 students and 40 senior faculty participated.

Industrial R&D Programs

- Indo- Canada Industrial R&D Program: 8 joint projects approved.
- Indo-Israel Industrial R&D Program: Besides three on-going projects, 3 new projects involving industry from two sides have been shortlisted for support.
- Indo-Swiss (DST-CTI): Joint call for proposal launched inviting industrial R&D project proposals.

Joint R&D Centres of Excellence

Support continued for 10 Joint Indo-Russian Centres of Excellence in their respective thematic area. These Centres are pursuing high-end science, working out new technologies and interacting with user community for possible technology transfer. These joint Centres are:

- International Advanced Research Centre for Powder Metallurgy & New Materials, Hyderabad
- Bharat Immunologicals & Biological Corporation Ltd, Bulandshahr
- Russian - Indian Centre for Advanced Computing Research, Moscow
- Indo-Russian Centre for Biotechnology, Allahabad
- Indo-Russian Centre for Gas Hydrates, Chennai
- Russian-Indian Centre for Ayurvedic Research, Moscow
- Indo-Russian Centre for Earthquake Research, New Delhi
- Indo-Russian Centre for Biomedical Technology, Thiruvananthapuram
- Joint Centre on Laser & Accelerators at RRCAT, Indore
- Joint Centre on Non-ferrous Metallurgy at NML Jamshedpur

Fellowships under Bilateral Frameworks

Outgoing Fellowships for Indian Scientists:

- DST-ICTP: Six Fellowships to Indian scientists for participation in 4 Scientific Events under India-ICTP Fellowship Programme.
- Lindau Nobel Laureates Meeting: 43 students/ young researchers were deputed for participation in the Meeting of Nobel Laureates and Students at Lindau Germany.

Incoming Fellowships for Foreign Scientists to India

- Research Training Fellowship for Developing Country Scientists (RTF-DCS Program) : This program (started in 2007) aims at enhancing India's attractiveness as a destination for getting developing country's post graduate S&T professional initiated into research or strengthening their research competencies by attachment with an Indian academic/ research laboratories as host for period ranging from 3 to 12 months.
- ILTP Fellowship: ILTP Fellowships were awarded to Russian scientists to work in Indian laboratories. Based on the recommendations of 15th session of the ILTP Joint Council, terms of this fellowship are being revised to Ramanujan Fellowship. It will provide better environment to the Russian scientists to Work in Indian laboratories in sophisticated manner.
- CV Raman Fellowships for African Researchers were launched in February 2010.

International Advanced Research Facilities- India's Engagements

- Facility for Anti Proton Research (FAIR): India intended to become member share holding country at the Facility for Antiproton and Ion Research (FAIR), at Germany. India announced its intention to contribute at least 3% of the total project cost of the FAIR. The FAIR Convention and other documents are being finalized and necessary approvals/ clearance of GOI has been processed.
- Indian beamline at KEK Japan: Under the Cooperation a dedicated beamline at Photon Factory KEK, Japan in being built by India with a estimated cost of Rs.20 crores over a period of 5 years. The beam has been handed over to India and the experiment hutch is being fabricated.

CHAPTER 4

SOCIETAL PROGRAMME

S&T FOR SOCIO-ECONOMIC DEVELOPMENT

Science for Equity, Empowerment and Development

The Department has been playing a pivotal role in promotion of science and technology for socio-economic development. In this direction, focus of the department is to create S&T based potential models to facilitate employment opportunities at grassroots level and enhancement of income and quality of life. Equal emphasis is being given on providing technological solutions to location-specific problems through technology modulation, field testing and transfer. Science for Equity, Empowerment and Development (SEED) Division of the Department supports such initiatives through S&T based voluntary organization/ institutions/ Colleges/ Universities throughout the country to take up action oriented projects to address location specific problems. Major achievements made during the year under various programmes/ schemes of the SEED division are listed below:

Science and Society Programme (SSP)

This programme aims at facilitating development of promising S&T based field groups and innovative technologies for addressing societal needs. It catalyzes research, development and adaptation of technology by supporting time-bound developmental projects and area specific network programmes to find solutions for problems in the rural as well as urban areas. Schemes operational under this programme are:

Long Term Core Support to Science and Technology based Field Groups

Through the Core Support scheme, S&T based voluntary organizations are supported on long-term basis to remain active in development, dissemination and implementation of appropriate technologies in rural areas. This year, core support was provided to 17 voluntary organizations in different parts of the country essentially to nurture and sustain scientific manpower to work on the core activities in their respective geographical coverage area. These groups are working at the grassroots level to train and empower local community with technological solutions in the area of water management, sustainable agriculture practices, agro-horti–processing for value addition, rural housing & sanitation, renewable energy and rural industries. One such group, Technology Informatics Design Endeavour (TIDE) based in Bangalore, has recently won International Ashden Award for excellence in the field of sustainable energy recognizing their work for disseminating efficient woodstoves and kilns which save atleast 30 per cent of fuel and are tailor-made for specific small industries. Such interventions are highly fuel-efficient, improve working conditions and bring environmental benefits.

Technology Interventions for Addressing Societal Needs (TIASN)

This scheme aims at developing and facilitating research and application of S&T based solutions to identified problems and societal needs. Some specific programmes/ projects covered under this scheme are as follows:

Technology Interventions for Elderly (TIE) programme aims to promote research, development and adaptation of technology for improving quality of life of the of Elderly population in the country.

- Under TIE programme, projects have been supported for development of technologies which are especially relevant to elderly people, including Assistive & Enabling Technologies (AETs) and related support systems. A web portal has been created covering information on issues related to S&T interventions in elderly care, such as assistive technology, home designs, health, nutrition and recreation. With involvement of subject specialists, guidelines on residential standards for elderly are being developed. Twenty scholarships at Master's level have been established at select IITs and other design institutions in the country to encourage students develop special designs for products useful for elderly. A group at IIT Delhi is working on development of wireless sensor network with the gait sensor(s) and integrated back-end monitoring system for detection of short-term and long-term gait anomalies in the elderly. The programme envisages culmination of the efforts with commercialization of these technologies with involvement of industry.

- A guidebook on nutritious recipes for healthy eating in old age in two languages has been compiled by Institute of Home Economics, Delhi

- Assessment of technology status of Old Age Homes in Metro and Tier-II cities is being done in a project.

- A project for pilot testing of a Mobile Elderly Unit (MEU) was supported to HelpAge India to meet elderly health needs by promotion of health care and wellness activities by screening and providing medical facilities at their door step. The concept is an upward evolution of Mobile Medical Units (MMU). MMU will provide preventive, promotive and curative health care through a combination of different systems of treatment, including timely detection of chronic diseases and motivating people to practice a healthy lifestyle.

- In order to assess the Assistive & Enabling Technologies (AET) needs of elderly people in India, a survey was conducted among a purposive sample of about 100 people in the age group of 60-85 years. The overall objectives of the survey were to sensitize and create awareness among the potential users of AET and concerned professionals, initiate the process of scientific assessment of the needs and to suggest strategies for advancement of AET. The survey was conducted with the help of a semi-structured Assistive & Enabling Devices (AED) Questionnaire. The results of this survey provided some useful insights to the issue of AET in India, including evidence of some of the perceived problems associated with the acceptance of AET.

Interface Programme for MBA (Rural Management) Students

In another innovative project, 15 students were given opportunity to interact with the communities in rural areas where SEED-supported projects are operational. As part of their Management Traineeship Segment (MTS), these students provide their professional inputs in various activities of the project and help the project implementing voluntary organizations in improving their skills, especially related to project management, financial management, marketing, etc. The students, in turn, benefit from the exposure they gain through active involvement in addressing the real life problems in rural areas.

Co-ordinated Programme Non-Edible Oils (AICRP-NEO)

A generic technology package for utilization of non-edible oil seeds has been adapted/ optimized, and is being implemented at ten locations under diverse field conditions involving NGOs with a focus on development of business plan for at least one raw material of the target area.

S&T Interventions Involving Jawahar Navodaya Vidyalayas

In a new concept, students of Jawahar Navodaya Vidyalayas (JNVs) are exposed to the real life problems prevailing in the village adjoining their school using S&T based solutions. Solution is worked out by students and teachers in participation with the local villagers, using local resources, traditional knowledge (TK) and appropriate technology interventions. The experiment is expected to imbibe the concept of "local solution with local resources through a judicious combination of TK and S&T", which will have a lasting impact in the young minds. The Programme has evolved well and presently being extended to other parts of the country.

Scheme for Young Scientists (SYS)

The SYS scheme is aimed at providing support to young scientists to pursue their bright ideas in undertaking socially relevant action research projects. Young scientists can either attempt field implementation of an idea which is already known or develop techniques for solving problems which do not have any solutions at present. Under this scheme, main thrust is to encourage academic institutions, national labs and other S&T institutions (including voluntary organizations) to develop societal projects involving young scientists. During the year, ten new projects were supported. Salient achievements under some projects supported are:-

- Under a project on utilization of *Grewia* fiber for making handmade paper and crafts items for income and employment generation, 150 women from 25 villages were trained. Two groups of ten young boys and girls each in using technology for handmade paper in making letter pads, file covers, greeting cards, bangle boxes, pen stands, paper bags etc.

Training of village youth in making of hand made paper

- Under a project "Fish Waste Management and its Socio-Environmental Impact Assessment in Cochin Corporation and Aroor Industrial Area", *i*dentification and selection of different user groups from

Self Help Groups (SHG's) and Cooperative societies was done and training was imparted to about 50 persons on different economically viable scientific methods of fish waste utilization and management.

- Under a project "A Study on Production and Application of Vermi-wash as a source of Income for Women in Sagar island, Sunderbans." by Vivekananda Institute of Biotechnology, Nimpith, interventions have enabled 16 women entrepreneurs in establishment of Vermi production units and enhancement of knowledge base about improved technologies.

Science and Technology Application for Weaker Section (STAWS)

The scheme "Science and Technology Application for Weaker Sections " promotes research, development and adaptation of science and technology for improving the quality of life of weaker sections. It also promotes large-scale demonstration of newer technologies. Twelve new projects were approved during the year. Details of some of ongoing/completed projects are given here:

- In the area of medicinal plant, a project "Cultivation, Post Harvest Processing and Value Addition of Medicinal Plants for Income Generation and Health Protection by Rural Women of the Weaker Sections" is being implemented by National Botanical Research Institute (NBRI), Lucknow near NBRI farm site. Medicinal plants such as *Acorus calamus* (Vacha), A*ndrographis paniculata* (Kalmegh), *Asparagus racemosus* (Shatawar) and *Mucuna prurita* (Kewanch) have been taken up for large-scale cultivation and Ayurvedic by-products formulations like. Giloe, Satva and Vasavleha. Wide publicity was given before and during the project implementation for popularizing the technology. Attempts were made to introduce Vacha and Shatawari for inter-cropping. Farmers are being encouraged to cultivate these medicinal plants along with other food/ cash crops. Four training programmes were organized for 397 farmers on the cultivation and use of medicinal plants in primary health care.

- In a project on Economic Empowerment of Rural Fish Farmers through Skill Development in Freshwater Prawn Farming being implemented by Tamil Nadu Veterinary and Animal Sciences University, Fisheries College and Research Institute, Tuticorin, Tamil Nadu, total 40 freshwater fish farmers have been trained. A network has been established among them through web based groups and e-messages.

- Initiation of Integrated programme for income generating activities at Uttarkashi District by Society for Environment and Employment Development (SEED), NIM Road, Joshiyara, Uttarkashi. Project has focus to organize unemployed young boys and girls of rural areas for transfer of technologies on floriculture, floricraft and vermiculture for self employment generation.

Tribal Sub Plan (TSP)

The Scheme "Tribal Sub Plan" of the DST aims at improving living conditions of Scheduled tribes through need based S&Tinterventions. During the year, 32 new projects were sanctioned related to technology customization and delivery for empowerment of tribals in different parts of the country. Some of the projects are as follows:

- Improved practices for higher income through management of oilseed crops in tribal areas of Orissa.

- Fish seed production and ranching in Chalakudy River for improving the tribal livelihood of Vazhachal Forest Division, Western Ghats.

- An incubation support centre of technology skill up-gradation and design development on woolen garment at Ziro, lower Subansiri district, Arunachal Pradesh.
- Local area coordination project on system of Rice Intensification in Jharkhand tribal villages.
- To develop low cost flood irrigation system aimed at sustainable development of livelihood of tribal farmers in Yavatmal district of Maharashtra.
- Introduction of improved technology for production of bone meals and its application for betterment of socio-economic status of Mizo cultivators.
- Mushroom spawn production, cultivation and post production management for better nutrition and economic empowerment of tribal women in Boudh.
- Promoting community based enterprise of tribal communities through technology transfer for Sal leaf plate making in select village of Mayurbhanj district, Orissa.
- Network programme for the development of Angora Wool Sector to enhance income and employment opportunities in tribal areas of five district of Uttarakhand.

Highlights of Ongoing Projects & Network Programmes

Ongoing Projects

A project on S&T interventions for sustainable livelihood development of Kutia Kondhs tribals was undertaken in Kandamal district of Orrisa. As a model, 65 acres of land was developed by terracing, leveling, stone bunding, multi-purpose vegetative bunding, fencing, strategic crop growing and horticultural plantation. The developed land provides additional income through vegetable cultivation. Several technologies have been demonstrated for perennial hill stream based gravity irrigation and low cost drip irrigation through Bucket and Drum kits resulting in optimum utilization of the household level waste/ surplus water and other small water sources. These interventions have resulted in recovery of sloppy lands, affected due to degradation and repeated crop failure to productive lands increasing the incomes of marginal tribal farmers.

Traditional Seed Preservation by Tribal Women & Stone Bunding to reclaim degraded land for Agriculture purpose at Kandamal district, Orrisa

Establishing small scale coconut extraction units in Nicobar Islands: This project has aimed at optimizing the process for production of Virgin Coconut Oil (VCO) to fetch premium prices from the pharma and perfume industry for its use as a raw material and as a base for soaps and cosmetics. For improved production, prototype testing for modified press machine has been field tested and optimized for ease of operation. The processing rate is reported over 60 coconuts per hour and the extraction is 38-40% coconut milk from grated coconut. Self Help Group has been organized for production of VCO in the Project area consisting of Car Nicobar and its nearby Islands with proper marketing mechanism.

In another project, 100 honey collectors in Sheopur district, Madhya Pradesh were trained in scientific honey harvesting techniques along with processing, packaging and storage. A unit for honey processing, packaging and storage has also been established. Honey harvesting kits comprising sting dress, ladder, torch, honey extractor, knives, bucket and containers have been provided for safe and aseptic collection of honey. These interventions have enabled production of quality honey.

Promoting Community based Enterprise of Tribal Communities through Technology Transfer for Sal Leaf Plate making in Selected Villages of Mayurbhanj district, Orissa: The project intends to organize tribal women to take up enterprise activity for technology transfer on Biomass fuelled sal leaf plate machine to make diversified products through Self Help Group (SHGs). Fuel efficient stoves are successfully experimented under field conditions by linking it with Biomass Machine developed by IIT, Kharagpur. Total 20 SHGs are now engaged in Sal leaf plate making and other diversified products.

In a project on amelioration of the economic status of tribal women through reclamation and stabilization of wastelands in Udaipur, Rajasthan by cultivation and semi processing of *Aloe barbadensis* and *Chlorophytum borivilianum,* 90 women were trained. Value added products from *Aloe Vera* such as juice, dried aloe flanks & powder were standardized. The annual income from traditional agriculture that tribal women fetched increased by over 40 per cent due to this diversification and value addition. The organization has developed a machine for efficient cleaning of the roots of *Chlorophytum borivilianum.*

Technology Transfer of Scientific Cultivation Techniques and Practices of Floriculture to Marginal Tribal Farmers for Livelihood Improvements: 100 tribal people mostly labourers in coffee estates were given training on growing commercial flower crops as alternative livelihood in their homestead gardens at Yercaurd, Salem district, Tamilnadu. Besides giving training on growing commercial flower crops such as Chrysanthemum, Marigold and Roses, a model green house has been put up, where high value cut flowers and crops such as rose, gladiolus, carnation, orchids, anthurium, lilium and gerbera have been grown. Apart from this, the tribal are taught other value added programmes like flower arrangement, dry flowers techniques which will help them to generate extra income.

Strengthening Livelihood of Scheduled Tribes in Sangla Valley, HP through Technology Interventions: Under this project, clonal propagation of *Picrorhiza kurrooa*, and broadcast sowing technology of *Swertia* sp. (Chirata) and *Aconitum heterophyllum* was demonstrated to the tribal farmers under polyhouse and field conditions in Sangla Valley, District Kinnaur, Himachal Pradesh. Initial long gestation period in cropping of these high value-high demand-less volume crops require supplementation of farmers activities with short duration avenues for augmentation of their income. To meet with this immediate requirement, tribal people were motivated to take up household tourism under Home Stay Scheme and link their culture, craft, traditional agriculture practices and produce as value added services to set up household enterprise. 28 households have been registered with the Department of Tourism Govt. of H.P. To strengthen the community role and active participation, efforts are in progress to provide day to day

crop maintenance training, value addition of traditional agriculture crops and marketing through their organization as federation to sustain the post project activities as Bio-tourism Model.


Demonstration for Polyhouse Fabrication & Preparation of Traditional Dishes at Sangla Valley, Kinnaur, HP

Network Programmes

Capacity Enhancement for Sustainable Agricultural Development and encouraging Entrepreneurship Development based on simple rural technologies within the tribal areas of North East India at seven locations. These technologies include Production Enhancement Technologies; Soil Erosion Control Technologies; Water Management Technologies; Post Harvest Technologies; Nursery Techniques. This network programme with technical and co-ordination support of G.B. Pant Institute of Himalayan Environment and Development, Itanagar Unit in partnership with seven NGOs has benefited and empowered total 1540 lead tribal farmers in 49 villages covering six states. Total 69 SHGs have been formed involving 11 tribal communities who have adopted these technologies in their operational areas.

People & Protected Areas: Under this innovative network programme being implemented at 11 locations to address the issues of conservation as well as alternative livelihoods to tribal people around protected areas**,** WWF-India is implementing a project, "Integrating Conservation and Livelihoods around Purna Sanctuary in Dangs, Gujarat" in Dangs district of Gujarat involving Konkani, Warli, Bhil and Kunbi tribes. Project is aimed to promote sustainable farming practices to ensure that the impact of *raab* on forests is minimized and that the output from the land also increases. Local communities of select villages have been trained through demonstration plots on Systemic Rice Intensification (SRI) cultivation, improved techniques of growing traditional rice and nagli (finger millet) crops, raised-bed technology for seedlings nursery, and vermi-compost making. In addition, the community has been encouraged to plant trees which are more useful for fodder, fuel, medicinal value as well as for use in composting. The project also aims to explore options for value addition of traditional crops like *nagli* and *kharsani* into baked products like biscuits and nankhatai.

Similarly, RRDRO a voluntary organization is implementing another project, "Promotion of Handicrafts made by *Tharu* Community using Local Fibers/Material" in Sirsia block, Srawasti district of Uttar Pradesh located on the periphery of the Suhelwa West Range of Suhelwa Sanctuary. The Suhelwa Sanctuary is at the centre of a significant conservation zone known as the Terai Arc Landscape. The *Tharus* have a rich handicraft tradition and use natural grasses and material to fashion household items. The Project is utilizing

these traditional skills for income generation by using natural and locally available fibres to design products for an urban market and for this they are being supported with technical and design inputs. The familiarity of the *Tharus* with weaving fishing nets proved to be useful in training them in weaving *durries* using looms which involved working with the weft and the warp. The *Tharus* have learnt to replicate designs from graph paper and have mastered the more complicated geometrical patterns. RRDRO is now working with designers, master craftsmen and the artisans in improving the quality of the carpets in terms of its finishing, to come up with better designs and colours using natural dyes, and also to improvise new products based on wool.

Livelihood Diversification: **Tharus engaged in weaving dhurries**

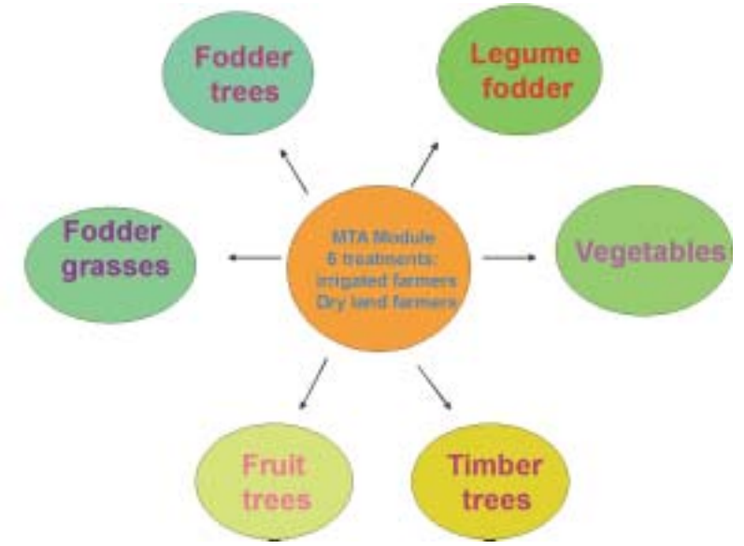
Scheduled Caste Sub-Plan for the development of Scheduled Caste Population (SCSP)

Under this scheme, special emphasis is placed on the S&T based empowerment of the Scheduled Caste population through capacity building, improvement in existing technology and promotion of innovative technology. During the year, twenty three projects were sanctioned in the technology areas such as rural engineering and micro enterprise (livelihood), sustainable utilization & value addition of natural resources, promotion of sustainable horticultural technology, skill improvement and efficiency in traditional occupations, animal husbandry particularly relating to smaller animals, alternative vocation for income generation, etc. Some of the projects which have made visible impact on the well being of the poor Scheduled Caste population are as under:

- An exercise is underway for S&T Planning for identifying development needs of SC population in selected States and developing strategic action plan for an integrated Mission on S&T driven sustainable development with an objective to work out a comprehensive package of S&T inputs for the state level mission on sustainable development of SC population in the States of North- Uttar Pradsh, Bihar; East- Orissa, Jharkhand; West – Rajasthan, Maharastra and South- Andhra Pradesh & Tamil Nadu.
- Large scale demonstration of scientific water management technologies on marginal farmers' fields in Malaprabha command area has been initiated under a project sanctioned to Dept. of Soil Science &

Agricultural. Chemistry, University of Agricultural Sciences, Dharwad. Data on soils, cropping pattern, current irrigation practices, ground water resources, and socio-economic aspects have been collected and analyzed. SC/ST farmers have been chosen for mass scale demonstration of water management technologies. Demonstrations on improved scientific irrigation methods on farmers' fields have been taken up during rabi/summer and Kharif seasons and participatory recording of observations with respect to growth and yield parameters have been conducted on farmers' fields.

- A Multi Tier Agri (MTA) Schemes for Livelihood Enhancement of Subsistence Farmers in Hosur district of Tamil Nadu has been initiated for developing MTA modules to include multi cut grass, fodder trees, timber trees, fruit trees and legume fodder; upgrading feed to increase milk production for farmers having milch cattle. The initiatives involve feed management, facilitation of technology transfer through demonstrations & training programmes. The main idea is to increase milk production in HF cross and the indigenous breeds of the area. Various species of trees like teak, mahogany, fodder trees like Sesbania, Glyricidia, Cassia, fodder grasses like CO1, Stylo, Maize, Bajra along with fruit trees and vegetables were cultivated in Multi tier modules adopting Spatio-temporal arrangements. About 60 beneficiaries have been trained in this programme in the past two years.



- Under a livelihood enhancement programme in six districts of Tamil Nadu, training on modern scientific method of apiculture has been provided to the scheduled caste population by promoting rearing practice of high yielding honey bee and making value added products**.** Focus of the training has been on varieties of honey, migratory bee keeping and artificial queen rearing to produce new colony by involving 360 trainees and establishing 3 training centres. This is an alternative employment opportunity identified to wean away SC women in these areas from undertaking hazardous beedi rolling.

Network Programme on Resource Management and Development for the Empowerment of Scheduled Castes

Recognizing that the scheduled caste community is one of the vulnerable sections of our society and the socially disadvantaged amongst them have to be brought in to the main stream through an integrated

approach leading to not only economic empowerment but also social equity The department has initiated this network programme aiming to develop SC Community through mobilizing them, utilizing the local resources, and transferring appropriate technologies. The programme was initiated after consultation with voluntary organizations and S&T institutions from the thirteen states of country. This has led to the development in 40-45 villages in the northern and southern states where SC communities are predominantly residing.

Projects under this programme are located in Jammu & Kashmir, Himachal Pradesh, Uttarkhand, Kerala, Andhra Pradesh, and Tamil Nadu, where the selected SC communities are engaged in unskilled seasonal labour. The target area includes costal villages, hilly areas, and plain/drought areas. A member of the community is involved as a project staff ensuring the ownership of the programme. The programme component mainly includes addressing of social issues, adoption of technologies in the field of water, sanitation, livelihood development, and micro enterprises development utilizing local resources. The progress of the programme and performance of the organizations are monitoring every six monthly. The unique features of this programme are:

- Mobilization of the community and facilitating local training centers and production/service units for market based skill development;
- Training of women in technology areas such as nutrition garden, poultry, goatry, rabbit rearing, azolla, composting, mushroom, soap making;
- Introduction of technologies for rain water harvesting, ground water recharging, open well recharging, soak pit technology, solar water purification; &
- Sanitation technologies including two pit and compost toilets, and kitchen waste based bio gas.

Thereby initiating local resource based livelihood activities /micro enterprises by forming beneficiary(functional) groups Viz. cattle feed development unit, herbal production unit, plant nursery units, banana fiber extraction & its product development unit, flour production unit, fruit & vegetable based production unit, and Emu rearing units.

These initiatives have motivated the community and created ownership among them. In addition, these activities have contributed to the enthusiasm of SC women and youth towards self help activities. The community was motivated to share the knowledge and materials to other deprived villages as 'Shridan', a community initiative. Based on the progress of the first phase projects, the programme has been extended to the states of Madhya Pradesh, Maharashtra, Gujarat, Rajasthan, Karnataka and Pondicherry for which brain storming, orientation, project formulation workshops and Sub Expert committee meetings have been already organized.

Some of the successfully completed projects include:

- 60 SC youths were trained in Skill Development in Plastics Processing Technology, Injection Moulding Technology, FRP Technology, Familiarization and Operation of CNC Machine in Tool Room and Auto CAD at CIPET, Lucknow.
- Skill upgradation training for SC/ST marginalized women on screening printing was imparted.

S&T ENTREPRENEURSHIP DEVELOPMENT

National Science and Technology Entrepreneurship Development Board (NSTEDB) aims to foster technology based and knowledge driven entrepreneurship among S&T persons through its programmes and activities. Achievements in brief are described below:-

Technology Business Incubators (TBIs): Coupling Knowledge to Wealth Creation

Business Incubation has been globally recognized as an important tool for economic development as well as job and wealth creation. Technology Business Incubator (TBI) is a flagship programme of NSTEDB and focuses on tapping and incubating the potential ideas and innovations through a well defined venture /enterprise creation process and by effectively utilizing the requisite expertise, facilities and other infrastructure available within the host institution and in the adjoining region.

The rate of incubator formation which was a trickle in the 1980s and 1990s has gained momentum in the current decade. During last three years new Incubators have been set up and now over 50 incubators are functioning in the country. Efforts are underway to bring the TBI's magnitude much closer to a critical mass.

Establishment of new TBIs

Following new TBIs were accorded approval for establishment in 2009-2010.

1. Manipal Institute of Technology, Manipal- focusing on ICT and health care technologies.
2. D.K.T.E. Society's, Textile & Engineering Institute, Ichalkaranji-in the area of Textile technology and design.
3. St. Peter's Engineering College, Chennai.-in the field of refrigeration, air-conditioning and cold chain.
4. Kalinga Institute of Industrial Technology, Bhubaneshwar- in the area of Pharma-biotech, Bioinformatics, Exploitive Micro-biology, Agri-tech & Information technology
5. Global Incubation Services, International Technology Business Incubator at Bangalore by JSS Mahavidyapeetha, Mysore.

Initiative on Seed Support System for Incubators and Incubatees

During the year, the seed support system for start-ups of STEPs/TBIs to enable timely availability of seed stage funding of technology led start-ups in the TBIs was sanctioned to the following STEPs/TBIs

1. STP, University of Pune
2. CIIE , IIM Ahmedabad
3. IIT Kharagpur

National Award for Technology Business Incubators for the year 2008

For consistent contributions towards fostering the spirit of entrepreneurship by nurturing new enterprises, the National Award for Technology Business Incubators for the year 2008 was conferred on Vellore Institute of Technology- Technology Business Incubator, during the ISBA Conference held in New Delhi .

Shri Prithviraj Chavan conferring National Award for Technology Business Incubators for the year 2008 to Vellore Institute of Technology

First status report on STEPs/TBIs

With the support of NSTEDB, DST, the first status report on "Technology Business Incubation in India" was prepared and brought out by ISBA. The data and findings presented in the status report as a joint effort of NSTEDB, DST and ISBA would help all relevant organizations, stakeholders and people connected with the business incubators to shape up their offerings for better overall effectiveness of the incubator program and help and build the desired ecosystem for innovation and entrepreneurship.

An informative document, 'Developing Ecosystem for Knowledge to Wealth Creation –Technology Business Incubators' was prepared and brought out by the TBI Secretariat with the objective to fill the gaps in the availability of information on all aspects of the business incubation activity. This document has been designed as a conceptual and base-level information source on incubators that will be constantly expanded and updated. The contents of the document would help institutions to devise a good incubator program, which would enable incubate entrepreneurs to be successful and incubator to succeed.

International Events

Asia Pacific Incubation Network (APIN) supported by NSTEDB, DST and *info*Dev, World Bank having Secretariat at PSG-STEP, Coimbatore has come into existence and will focus on the following activities:

- Capacity Building for the Business Incubation Managers
- Addressing the challenges faced by the Asia Pacific Incubation Community
- Establishing an e-platform where the incubators can exchange information.
- Facilitating the soft landing of the incubatees in the network countries.

APIN Organised two important programs during the 2009-10

- APIN organised 4th Asia Pacific Conference on Business Incubation with the theme 'Global Recession– An opportunity for Business Incubation' during 6-7 August 2009 in Coimbatore. The event brought together great minds in Incubation, promoters and other partners in business incubation across the globe. There were 250 participants from Incubation arena with over 25 International delegates. The conference focussed and deliberated on issues and trends in business incubation at time of global economic meltdown, complementing factors for incubation, incubation mapping, latest incubation tools and techniques, new perspectives for development and future hold for development of Innovation and Entrepreneurship through Business Incubators in the Asia Pacific region.

- Capacity Building Programme for Business Incubation Managers was held during 10-14 December 2009 at Ooty (near Coimbatore), in which 25 Incubation Managers participated which also included 10 international participants.

ISBA 2010 Conference: The Indian STEPs and Business Incubators Association (ISBA) organized 4th Conference on Business Incubation during 8-10 February 2010 in New Delhi. The focal theme of this conference was 'Innovation through Incubation: Way forward for Sustained Inclusive Growth. The Conference was supported by NSTEDB and was inaugurated by Hon. Shri Prithviraj Chavan, Minister of State (Independent Charge) Ministry of Science and Technology. There was congregation of about 300 participants and experts who form the who's who of the Indian business incubation fraternity, incubatee companies, government agencies, financial institutions and leading hi-tech industries and participants and speakers from various countries across the globe. The presentation of 2nd ISBA Awards to 9 Incubatee Companies functioning in various sectors like ICT, biotechnology, clean technology, materials, manufacturing and inclusive growth technologies (details at www.isba2010.in) was also held during the inauguration.

Entrepreneurship and Innovation Programmes

A new scheme called **Innovation and Entrepreneurship Development Centre (IEDC)** was launched during 2009-10. The main aim of this scheme was to develop an institutional mechanism to create entrepreneurial culture in academic institution to foster the growth of innovation and entrepreneurship amongst the faculy and the students. IEDCs would support innovative student projects which may at a later date be supported through the other programmes Technology Business Incubators. During the year 6 IEDCs were established.

Science & Technology Entrepreneurship Development (STED) Project aims to bring socio-economic development in a region by promoting entrepreneurial temper and motivating unemployed youth for establishing micro enterprise based on innovative skills and technology. STED Project is currently operational in 48 locations across the country. During the year, through STED projects, about 2500 units have been promoted.

Thirteen new projects were established during 2009-10 located at Bijapur (Karnataka), Guwahati (North East), Faizabad (Uttar Pradesh), Gajapati (Orissa), Rae Bareli (Uttar Pradesh), Nalbari (Assam), Roorkee (Uttarakhand), Goalpara (Assam), Saraikela (Jharkhand), Surendranagar (Gujarat), Narmada (Gujarat), Harda (Madhya Pradesh) and Bundi (Rajasthan).

STED project with dedicated output and especial focus in promoting women entrepreneurship have also been initiated.

Faculty Development Programme (FDP) is designed to train and develop professionals in entrepreneurship development so that they can act as resource persons in guiding and motivating young S&T persons to take up entrepreneurship as a career. Through each FDP, 15-20 faculty members of Science and Engineering colleges, Polytechnics and Entrepreneurship Development Organisations are trained for a duration of 2 weeks. During the year, 92 FDPs have been conducted all over the country.

Technology Based Entrepreneurship Development Programme (TEDP) focuses on transfer of technologies from lab to entrepreneurs through structured training programmes. This year 129 TEDPs have been organised with support from NSTEDB.

The **Entrepreneurship Development Programme (EDP)** is a training programme in which persons with S&T background are trained both in entrepreneurial and managerial skills for setting up and running the enterprises. The training is provided for 4-6 weeks including field exposure. During 2009-10, 123 EDPs including dedicated programmes for women have been held.

Skill Development Training through S&T (STST) aims at demonstrating the effectiveness of short term market oriented technical skill training in empowering unemployed youth to earn a sustainable livelihood. More than 8,000 youth have been trained during this year.

NSTEDB sponsors **Entrepreneurship Awareness Camps (EACs)** of 2-3 days duration in educational institutions to inculcate spirit of entrepreneurship amongst students pursuing degree/diploma courses in S&T streams and also amongst the faculty. During the current, about 560 EACs have been supported for the benefit of students and faculty.

Science Tech Entrepreneur, an E-zine has been brought out to disseminate information on various aspects of entrepreneurship technology finance and management to budding as well as established entrepreneurs.

NSTEDB, in partnership with Indo-US Science and Technology Forum (IUSSTF), and Intel, is implementing Technology Entrepreneurship Programmme. Under this programme India Innovation Pioneers Challenge 2009 was organised and five student teams were awarded prizes under different categories. Exposure of faculty on global entrepreneurship leadership was also organised at UC, Berkeley.

India Innovation Growth Program is a collaborative project of NSTEDB and Lockheed Martin Global Inc. to identify, award and accelerate innovative new Indian technologies into the market space. Out of the 280 applications received, 70 innovators were invited for a commercialization workshop. Finally 30 innovators were given advanced training in technology commercialisation. At the end of the competition 15 winners were announced and given medals in June 2009. The medallists received professional business development assistance from IC2 Institute, University of Texas. A Technology Expo was organised to showcase the commercial success achieved under this programme.

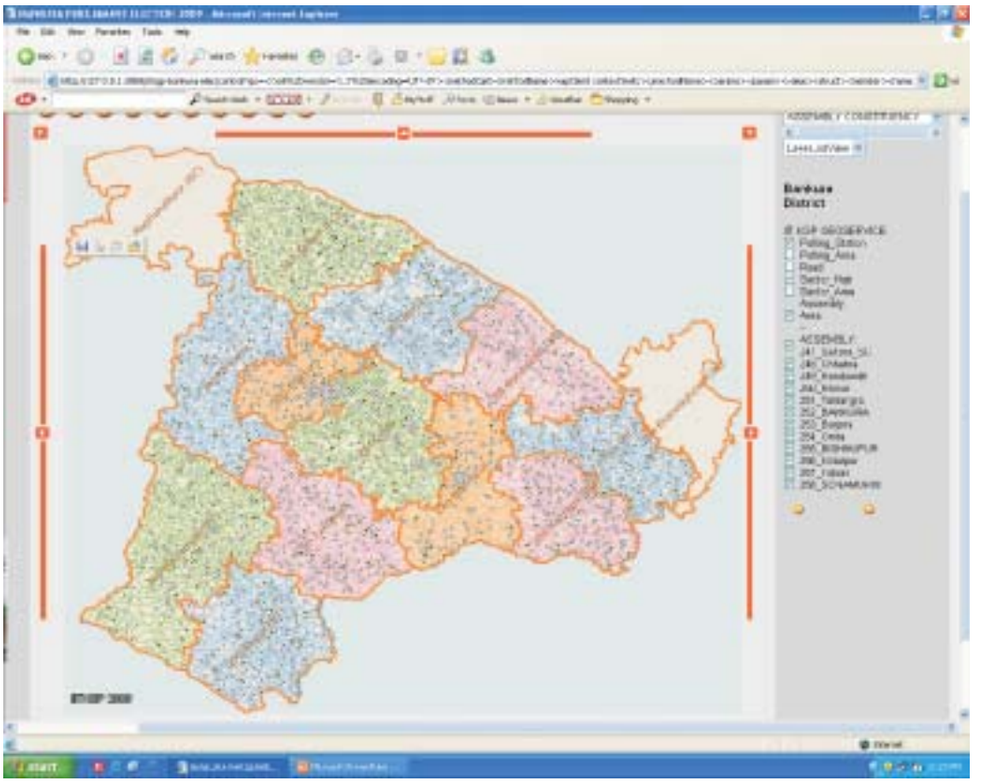
Technology Business Plan Competitions help students and researchers to develop and test their business vision and plans. Financial support was extended to academic institutes for organization of these Competitions so as to promote entrepreneurial culture in academics.

NATURAL RESOURCES DATA MANAGEMENT SYSTEM

Natural Resources Data Management System (NRDMS) Programme aims at promoting R&D in emerging areas of Geo Information Science and Technology. It develops methods and techniques for operationalising the concept of local level planning in support of the 73rd and 74th Constitutional Amendment Acts relating to the Panchayati Raj Institutions and Urban Local Bodies. During the year, district level Enterprise Geographical Information System (E-GIS) and State level Geo-portal prototypes have been demonstrated to user agencies, domain-oriented techniques and web-services for the sectors of Hydrology and Landslides/ Tsunami have been developed and tested, and advanced laboratories/ centres set up to build technical capacity and promote R & D in emerging topics like Spatio-temporal Data Modelling, Service-oriented Architecture, Sensor Networks, and Geo-visualisation.

District level Enterprise GIS

In a typical district, different Line Departments depend on a mix of software and information systems for meeting their information needs in day-to-day decision-making and operations. District NRDMS Centres, currently organised on the concept of 'Desk-top GIS', support Line Departments in meeting their geo-information needs by sharing/ exchanging data sets in the form of CDs or hard copy products. This makes the data updation and sharing inefficient and difficult. With the advent of high-speed networking technologies; intelligent, spatial-data serving techniques; geo-relational database systems; and geo-spatial interoperability standards, there has been a need to explore these in overcoming the problems of data updation and



(Figure 1: Screenshot of Bankura Assembly Constituencies showing polling stations retrieved through Web Map Service from the Bankura Enterprise Geographical Information System)

sharing. An Enterprise GIS (E-GIS) has been developed and demonstrated using the above tools and technologies with the involvement of the Line Departments of Bankura District (West Bengal). Organised on a Geo-Relational Database System, the data sets have been updated using Web Feature Service (WFS) and information from the database sharable with Line Department staff across the district using the Web Map Service (WMS). Both WFS and WMS conform to the specifications from the Open Geo-spatial Consortium (OGC). The E-GIS has been tested and demonstrated during the General Elections 2009 wherein information uploaded at the district NRDMS Centre by the District Magistrate on a day-to-day basis has been used by the Election Staff engaged in managing the elections throughout the district (Figure 1). User response has been encouraging.

State Geo-Portals

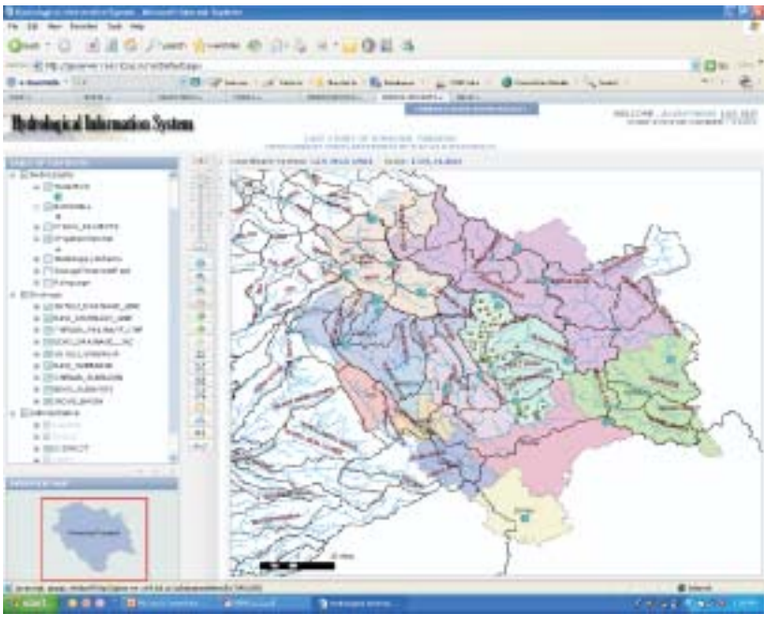
In order to support provision of up-to-date geo-spatial data to local level planning in the State, the Karnataka Geo-portal has been released during the annual event- NSDI 9- held at Pune on 22-24 December 2009. The Geo-Portal provides single window access to various geo-spatial data sets acquired and maintained by State level agencies including the Karnataka State Council for Science & Technology (KSCST), Bangalore. Accessible in the form of OGC-compliant Web Map Service (WMS), Web Feature Service (WFS), or Catalogue Service on Web (CSW), the data sets include various administrative boundaries, thematic maps, demography, socio-economy, and infrastructure facilities (Figure 2). Studies have been launched to develop similar Geo-Portals for West Bengal and the North East. Government of Kerala has adopted the Karnataka Model in operationalising the Kerala Geo-Portal.

(Figure 2: A screenshot from the Karnataka Geo-Portal showing selected districts satisfying a database query on the web based on user-specified search criteria)

Data Model for Statewide Hydrological Data Infrastructure

A comprehensive data model is an essential pre-requisite to building a hydrological data infrastructure on a State wide scale. Involvement of all the stakeholders within a drainage system, who together as a group, cooperatively work towards identifying various issues and concerns, develop and implement plans with

solutions for the potential beneficiaries of such an infrastructure. Relevant data needed to evaluate the cause and effect of all the proposed actions within a drainage basin are required to be collected, maintained, and shared with the stakeholders on a regular basis. A framework in the form of a data model is required for developing a database that could be used by all the stakeholders and updated by relevant departments that have designated jurisdiction over entry of appropriate data. A data model has thus been developed for implementation and testing using data sets from Himachal Pradesh. A Hydrologic Information System has been developed and demonstrated to the concerned Line Departments like Environment, Irrigation & Public Health, Energy, Agriculture, and Horticulture of the State Government using the data model (Figure 3). Capable of providing information on surface run-off, silt yield, biomass yield from a watershed following a rainfall event, the HIS could be accessed over the web by the stakeholders for collaborative work towards managing watersheds.



(Figure 3: Screenshot from the web-based Hydrological Information System for Himachal Pradesh showing location of water bodies, borewells, and irrigation schemes with sub-basin boundaries)

Advanced Laboratory on Geo-information Science & Engineering (GISE)

In order to promote R&D in different emerging facets of Geo-information Science and Engineering like Spatio-temporal Data modelling and Analysis, Service-Oriented Architecture based Geographic Information Sharing, Geo-visualization and Analytics, Software Engineering for Geospatial Systems, Geo-web/ Location Based Services, Sensor Networks, Workflow Management, an advanced laboratory on Geo-information Science & Engineering has been set up at the Department of Computer Science & Engineering, Indian Institute of Technology Bombay, Mumbai. The Laboratory is expected to facilitate closer interaction between different research groups in the area of Spatial Data Technologies for the achievement of long term goals in the field of Geo-information Science by leveraging the expertise and experiences available at various IITB Centres/ Departments, and other similar research organizations in the country. In order to fine-tune the research priorities, a workshop on "Geospatial Information for Developing Countries: Science and Technology" has been organised by the Laboratory on 16-18 December

2009 with the support from Indo-US Science & Technology Forum, New Delhi. Leading experts in Geo-information Science from US, UK, and Japan have participated in the deliberations. It has been agreed to help build an Indian Geo-spatial Community with the support of its counterpart from the US to further active research in the field. In addition, the Laboratory aims at creating a platform and repository for hosting technologies, applications and prototypes to promote the use of Geo-spatial Technologies.

Centre for NRDMS

A 'Centre for NRDMS' has been launched at the Department of Geography, Kumaon University, Almora to develop and demonstrate methods and techniques for better managing geo-spatial data assets of Uttarakhand State, build capacity of concerned stakeholders to support provision and use of up-to-date Geo-information for Decentralized Planning, and to conduct regular world-class training and research programmes in Geo-Information Science and Technology. Experience and expertise gathered by the Department over the years in developing and operationalising the Almora district database of NRDMS will be leveraged in achieving the above objectives. A Master's Course in Geo-information Science & Engineering has been initiated by the Centre around the artifacts and equipment available at the University.

Urban Flood Risk Mapping of Chennai City

Urban Flooding has been of concern with cities like Mumbai and Chennai facing havocs during monsoon season. In order to provide S&T solutions for urban flood mitigation and management in Chennai City, a joint project with the State Govt. has been initiated by NRDMS. A detailed spatial database has been developed with the help of Airborne Laser Terrain Mapping (ALTM) providing high resolution topographic information to build a Digital Elevation Model (DEM) with improved accuracy. Physical features like buildings, trees, roads, culverts, bridges, drainage having an influence on the flooding process have been mapped. Attribute data on rainfall, observed runoff in rivers, socio-economic condition of people, shelters, and medical facilities has been acquired through ground survey and integrated with spatial information in Geographical Information System for integrated processing and analysis. Flood Simulation Models like MIKE 21 and SWMM have been used to prepare flood risk maps identifying and quantifying areas and facilities that may be inundated for a given rainfall event. Information derived from the simulation has been helpful in quantifying stress on typical urban infrastructure like roads, electricity, and communications in order to draw up quick recovery strategies.

Tsunami Wave Propagation Modeling of Nellore Coast

Understanding the propagation of tsunami waves caused by earthquake of higher magnitudes is crucial to drawing up of effective disaster management strategies. The open sea tsunami wave propagation is defined by linear wave theories and with the wave reaching the shore, the effect of wave shoaling and wave breaking causes rise in wave heights inundating large areas on the coastline. Modelling tool like MIKE21 has been used to simulate the tsunami wave propagation and develop the model with the source parameters that caused 2004 tsunami. The model results have been validated with observations from the coastal tidal observations and similar model outputs from NGI, Norway. The validated model has been further used to predict the future possible scenarios to assess tsunami arrival time and shoreline wave heights.

The Amparav Landslide has been investigated with detailed geological and geo technical investigations. The area has been geologically mapped on 1:1000 scale with 2 meter contour interval to demarcate and identify high and very high hazard areas. In situ soil and rock samples have been collected to analyse and

estimate the shear strength of slope material. Using the slide software, stability analysis of the landslide affected area has been carried out to estimate the Factor of Safety (FOS) in wet and dry conditions. Based on the slope stability analysis, suitable preventive measures including design of gravity retaining wall has been proposed (Figure 4).

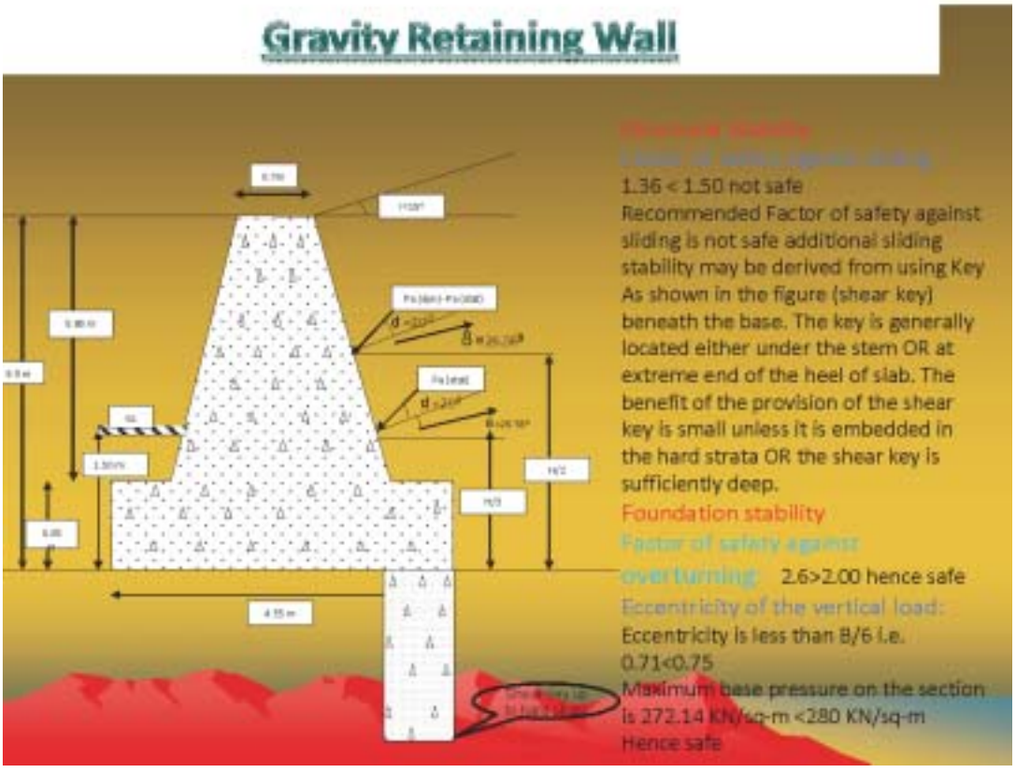


Figure 4: Proposed design for a Gravity Retaining Wall based on Factor of Safety

Training workshops

Centre for Geo-information Science & Technology, Kerala University, Thiruvananthapuram has organised a day long training programme on 25 August 2009 for the officials and staff from the State Ground Water Directorate on the improved techniques for ground water data management in the State. As a follow up, a web-based information system prototype is under development at the Centre for better maintaining the groundwater data sets of the Directorate. A week long training programme on 'Interoperability and Geo-web Services' has been conducted by IIT Kharagpur during 22-26 November 2009 to train scientists and officials from various participating institutions of NRDMS Programme and the Government of West Bengal. The participating scientists and officials have been exposed to the development and use of standards-based interoperable geo-web services in preparing local level developmental schemes. A Workshop on 'Police GIS' has been organised by the Center for NRDMS, Kumaon University, Almora on 16 January 2010 to train officials and staff from the Almora Police District. A National Workshop on 'Coastal Urban Floods' has been organised by the Department of Civil Engineering, IIT Bombay on 18-19 February 2010 to expose engineers and officials from the Municipal Corporations of Mumbai to the emerging technologies useful in managing floods jointly caused by rainfall and tides.

NATIONAL COUNCIL FOR SCIENCE & TECHNOLOGY COMMUNICATION

National Council for Science & Technology Communication (NCSTC) has been working towards developing newer ways and means for bridging the void between science and society and achieving the goal of better public appreciation of science and inculcating a scientific bent of mind amongst fellow citizens.

Science Express

'Science Express' a unique science exhibition-on-wheels displayed in a 16 Coach AC train, featured over 300 large format visual images, 150 video clips, multimedia exhibits and *Kids' Lab* of BASF India. Its inaugural edition primarily developed by Max Planck Society Germany (MPS) in collaboration with DST, and with operational field support from Vikram A Sarabhai Community Science Centre Ahmedabad (VASCSC), was flagged off by Dr. Manmohan Singh, Hon'ble Prime Minister of India and Dr. Angela Merkel, German Chancellor. Enthused by its widely acclaimed tour, which covered 57 locations in 214 days, and attracted 22.5 lakh visitors, DST launched Phase-II of 'Science Express' with some new & indigenous exhibits and Joy-of-Science Lab with experiments in Physics, Chemistry, Biology, Mathematics and Electronics. Since its launch on 30 November 2008, it visited about 50 destinations, mostly Tier-II &III cities not covered earlier. Over 13.5 lakh people have explored issues & challenges of science in a fascinating manner and also delved into the mysteries of our world, groundbreaking discoveries, emerging issues, cutting-edge in science and future-oriented technologies. 'Science Express' entered the Limca Book of Records with 4 records. It received extensive media coverage. Shri Prithviraj Chavan, Hon'ble Minister of S&T, the Chief Guest at the Valedictory Function on 30 May 2009 appreciated the achievements and felt that this path-breaking initiative further to areas not covered earlier.

The continued success of this mega classroom-on-wheels prompted DST to initiate the third Phase on 2 October 2009 from Gandhinagar. More indigenous exhibits were inducted by VASCSC, a dedicated coach on Climate Change which was fully sponsored by HSBC was added and due emphasis given to career counseling. Till end March 2010, about 15 lakh visitors had thronged the exhibition while about 50,000 students conducted hands-on experiments.

A flagship project of NCSTC, it has received overwhelming response and enabled DST to reach out to about 50 lakh people across the length & breadth of the country and rekindle their interest in science using interesting, interactive formats coupled with competitions, film shows, etc. at railway platforms. The feedback received from the visitors indicates that it is has been able to motivate and guide the young generation in pursuing Science as a career.

Hands-on Science (HSCI 2009)

The importance of learning by doing has been an old adage. This can be considered to be about internalizing the concept and the phenomenon by performing hands-on experience at it, thereby synchronizing *head* and *hands* together to achieve excellence in every walk of life.

The 6th International Conference on Hands-on Science (HSCI 2009), was organized at Science City, Ahmedabad, from 26 October to 1 November 2009, in association with International Association

Hands-on Science Network (HSCI Network), Portugal. The conference was aimed at enhancing the culture of innovation and experimentation in the modern societies with a fine blend of science knowledge and excellence for all. The focal theme of the conference was 'Science for All : Quest for Excellence'.

Five special Scientific Sessions with the following sub themes were organized i) Science, Innovation and Hands-on Science; ii) Science Communication through Hands-on Activities; iii) Experiences in Science Fun Learning; iv) Hands-on Science and Evolution of Modern Knowledge; v) Promotion of Scientific and Technological Temper

Over 350 delegates from 27 states, including some 40 foreign delegates have made 200 presentations in 5 scientific sessions. The Exhibition of Popular S&T Information Products and Hands-on Science Experiments showcased various hands-on experiments from across the world. Vigyan Prasar and NCSTC have put together hands-on science activity corners and exhibition.

Rashtriya Vigyan Sancharak Sammelan 2010

The 3rd Rashtriya Vigyan Sancharak Sammelan 2010 on the theme "Advances in Science Journalism– Role of Space Science and Technology" as part of 97th session of Indian Science Congress was held at Trivandrum during 4-5 January 2010. The participants of the meet were drawn from one day symposiums organized by ISCA Chapters at different places of the country.

Vigyan Evam Vikas Sanchar Kendra

In order to promote utilization of national resources developed as a result of science communication efforts and innovative practices of science resource sharing between the society and scientific knowledge generation agencies, an on-going pilot initiative has been reshaped, upscaled and launched as "Vigyan Evam Vikas Sanchar Kendras" (VVSKs) since November 2009. To begin with, Kendras are going to be supported in 11 states. Clusters of villages will be adopted as project area where the target groups/ beneficiaries are supposed to be students, women, disadvantaged sections of the society, families of defense personnel, workers/trade unions members, self help groups (SHGs), etc. A Kendra can be located in a public library, school/ college, Panchayat bhawan, or any other community supported premises, at village or block level.

Regional Innovation Science Hubs for Inventors

In order to promote creativity amongst young people and growth of economy based on science and technology, NCSTC is making concerted efforts to set up Regional Incubation Science Hubs for Inventors (RISHI) for the purpose of fostering children's dreams and passions for S&T. Talented students would be encourage to pursue ideas which have potential over a 3 week internship in one of the Centres identified by the Department.

Bicentenary of Birth of Charles Darwin

Bicentenary Celebration of birth of Charles Darwin and his Contribution "Origin of Species" was supported. Brainstorming workshops for development of resource material are being organized. Countrywide identification of colleges has started, where 2 days interaction session amongst noted biologist & graduate & post graduate Life Science students will be held and students will present papers on relevance of Charles Darwin's contribution in today's context.

National Meet on "Science For Sanitation"

A National Meet of participating States was organized on at INSA, New Delhi, with specific objective of enabling exchange of experience amongst S&T Councils/ Departments from observing "Science for

Sanitaion" Month. This is also to have feedback on limitations and potentials of the initiative as regards intended behaviour change, diffusion of best practices and accompanying growth of scientifc temper.

Water Literacy Outreach Multipliers

For re-inforcing S&T communication for Water and Sanitation Literacy, NCSTC is formulating a series of frameworks along with core syllabi for training and capacity building. S&T communication training modules have been designed and developed for Water Educators, Water Journalists, and Water Quality Monitoring by Young Citizen Scientists. The specific orientation thus imparted is going to boost the S&T inputs to media and communities both while making S&T communication more impactful. Module on S&T communication for capacity enhancement of members of Paani Panchayats is being taken up as a pilot in Distt. Sitapur (U.P.).

Science Communication Studies

Long term academic courses/programmes in S&T Communication/Journalism at Devi Ahilya Vishwa Vidalaya, Indore, Lucknow University, Lucknow were continued. Lucknow University and Purvanchal University have recently started research programme in this faculty leading to Ph.D in science communication. Anna University, Chennai is running a two years' M.Sc (S&T Communication) and a one year post graduate diploma in science journalism. The Indian Science Communication Society (ISCOS), Lucknow continued a training course in science journalism. Gandhigram Rural University, Gandhigram (Tamil Nadu) and Hyderabad University run semester courses in science communication. VBS Purvanchal University, Jaunpur continued a special paper on science journalism and a Post Graduate Diploma Course continued at Makhanlal Chaturvedi National University of Journalism and Communication, Bhopal. A special paper on science communication was supported at the Banaras Hindu University, Varanasi.

National Children's Science Congress - 2009

The 17th National Children's Science Congress (NCSC), one of the most prestigious scientific event integrating children and science, was organized in Gujarat Science City, Ahmedabad, co-hosted by SGVP

Child scientists standing for a Scientific India

International School in Ahmedabad, during 27 – 31 December 2009 on the theme "Planet Earth-Our Home, Explore, Care and Share". Hon'ble Vice President of India, Shri M Hamid Ansari inaugurated the grand event.

About 560 scientific problems on societal issues were presented by the child scientists of 10 to 17 year of age in their respective vernacular language by 271 boys and 289 girls in 48 sessions. This indicates rising share of girls' child scientists in science studies and desiring a professional career in science and technology for societal development. More than 48,000 school & college students from in and around Gujarat got the chance to visit the Congress and took a message that science is simple and fun. 43 eminent scientists and researchers joined as evaluators and recommended 25 projects as special projects for further research and exploration. The programme succeeded in creating hype among the local as well as mainstream print and electronic media, for broader outreach and wider participation.

Initiative for Research and Innovation in Science (IRIS)

IRIS is a nationwide research based science competition targeting school children from 5th to 12th Class. The key partners of this program are Intel, CII & DST. The objective of this program is to popularize science, research and engineering and foster a spirit of innovation amongst high school students. This program has reached out to more than 20,000 schools, impacting more than a million students across India.

IRIS National Fair, 2009 was held at Sattva Vikas school, Ahmedbad during 26–28 November where 82 research based projects were selected from over 1200 synopses received. 8 projects (5 individual and 3 team) were then selected as National Fair winners. After a series of coaching camps, 6 projects (4 individual and 2 team) are going to participate in Intel International Science and Engineering Fair, ISEF in the USA. IRIS has launched its own website in 2009. Participants can view programme updates, news, winner's details, programme collaterals on this website. Along with the website; it also has a feature where students could participate by uploading their synopses online.

Year of Astronomy-2009

The Year of Astronomy-2009 was celebrated across the country. Resource Persons Training programme, State level activities and observation camps involving students and general public during the rare astronomical phenomenon- Total Solar Eclipse on 22 July 2009 and Annular Solar Eclipse on 15 January 2010- were organized. Mobile Planetarium for popularization of Astronomy too was provided.

Communicating S&T for Water, Sanitation & Hygiene (WASH)

S&T Communication for 'Eco-water & Sanitation Literacy' has taken the form of many visible field programmes, apart from the new dimension of training/ capacity building modules for Water educators, Water Journalists, Water Quality Monitoring and Paani Panchayats. Under the programme a gamut of activities, projects/ initiatives are taken up through science based voluntary organizations, universities, home science colleges, technical institutions, research laboratories, and State S&T Councils/ departments, etc. It is expected to bring social pressure on municipal and panchayat bodies, opinion leaders, decision makers etc. on prioritization of hygiene, sanitation, waste treatment and disposal and other such issues. Field interventions are supported through Development Science Communication with a variety of "Interactive Participatory Communication Formats", like Technology & Development Communication, Demonstrative communication, Communicative action & participatory learning. NCSTC supported month long Eco-

water Literacy campaign for implementation by respective S&T Councils/ Departments starting on the occasion of World Water Day- 22 March- every year.

Science for Sanitation Month

This is third year that the majority of States have joined in implementing the programme, a month long campaign starting every year on 2nd October, 'Science for Sanitation Month' with sharing of cost basis. During 2009, support was extended to Andhra Pradesh, Bihar, Chandigarh, Chhatisgarh, Goa, Lakshadweep, Madhya Pradesh, Maharashtra, Manipur, Mizoram, Nagaland, Punjab, Rajasthan, and U.P.

Animal Life Issues

To create awareness and build capacity among people about animal life issues, with special reference to Animal & Human Health, the new programme proposals were developed with the objective of improving the hygiene and sanitation of animal and human beings, reducing communicable diseases from animal to human beings, improving animal life with better natural resources management and increasing income from animal based food and other products. Projects on training of communicators, developing software, recognizing excellence, pilot field projects, etc., were developed.

Motivational Programme

To encourage bright students to select careers in S&T and kindle their interest in science, technology and research, motivational programmes were organized in various universities and research institutions with the support of S&T Councils, S&T based agencies or directly by the research institutions. 25 to 30 bright senior secondary students spend quality time in research laboratories; interact formally or informally with eminent scientists. They are also encouraged to take up hands-on S&T projects during such programmes. A number of such programmes were organized in 2009-2010.

Science Communication Archives

A science communication archives has been developed to preserve and retrieve science manuscripts, publications and other such materials to facilitate scholars and researchers in science communication to get authentic information on this subject. A number of rare books, documents, manuscripts, letters and notes, etc., pertaining to science, technology, scientists and scientific institutions are required to be preserved, as these consist an important part of our heritage and have long lasting value. .

Water Quality Monitoring through Schools

By way of a project implemented by IIT, Delhi, awareness has been created on water quality monitoring and dissemination of the technology and practices for rapid water testing at selected rural schools. The schools teachers & students have been trained in inculcating these practices at household levels. Training has also been provided to the schools community to use the kits for monitoring of local water sources with a proper understanding of the principles involved and scientific appreciation of potential/ limitations of using rapid field testing kits.

Safe Water Campaign

The Institute of Applied Sciences, Allahabad has completed a project on "Awareness campaign for eco-friendly water conservation and purification among the rural folk around Allahabad" to ascertain and

configure the necessary dimensional change in the socio-economic status of the population and role of governmental and non-governmental agencies in improving their status. Training have been imparted to the students and general population for the purification and conservation of water through community programmes to educate the local population through awareness campaigns for understanding the preventive and promotive strategies of health care for improving their overall status of health. 46 Chaupals and *Pani-panchayats* were organized in and around four *Kendras* to not only spread awareness but also to adopt conservation and safety measures to store and purify available water for drinking and other purposes.

Combating Occupational Health Hazards of Women

A unique programme has been conceptualised and initiated to address health issues among women employees in unorganized sector under the overall initiative of Government of India on Gender Budgeting. Keeping in view the diversity and wide range of the problems, an effective strategy has been worked out for sensitizing the employer, training employees to take appropriate safety measures and prevent avoidable occupational health problems in women working in 14 occupations– stone crushers, readymade garment

Hazardous occupation – women working in stone crushing industry

industry, call center employees, glass industry, electronic industry, municipality workers, salt pan workers, etc. Charts, posters, films and manuals are being prepared on healthy work practices and utilized by science communicators.

Total Solar Eclipse: Bangle In The Sky

On 15 January 2010, the longest annular Solar Eclipse of the millennium occurred. The ring of fire was visible in the sky for 10 minutes in the southern most areas of India covering parts of Kerala and Tamil Nadu. NCSTC, together with Vigyan Prasar and Tamil Nadu Science & Technology Centre, Chennai organised an observation camp in Kanyakumari. Around 700 Students of VIPNET clubs from all over the country with their teachers and science club coordinators participated in the camp at Kanyakumari. They gathered at the helipad and viewed it from 11.05 a.m. till 3.05 p.m.

Total Solar Eclipse: Diamond Ring in the Sky

NCSTC organized a number of activities built around the natural phenomena during the Year of Astronomy. The celebration of IYA has been started with the observation of Total Solar Eclipse of 22 July 2009 through the belt of totality passing through mid-India. Lakhs of people came out of their houses to

view the longest astronomical phenomenon. NCSTC also developed one solar kit and disseminated it along the belt of totality after its proper demonstration.

Students enjoying the view of Total Solar eclipse

Understanding Planet Earth

An awareness generation programme for Understanding Planet Earth in many districts of Uttarakhand State was organized by PAHAL, Pithoragarh. Energy Research Association, Haryana organized similar campaign in many districts of Haryana. SPECS, Dehradun organized lectures-cum-demonstration on different topics like water and sanitation, environment conservation, hazard management and climate change to commemorate understanding planet earth campaign.

Perfect Health Mela

NCSTC participated in the Perfect Health Mela organised by Heart Care Foundation of India during 3-17October 2009 at Laxmibai Nagar Park New Delhi. NCSTC put up its activity corners that attracted thousands of visitors. Competitions for student of medical and nursing colleges were orgnised and theater performances on science communication were held.

National Science Day

Many institutions have organized a series of activities that span over a month or even longer, usually beginning with or culminating on February 28, the National Science Day. The theme selected for 2010 is "Gender Equity for Peace & Prosperity". The activities include among others- 'Open Day' for the public in scientific institutions, science exhibitions, popular science lectures, quiz programmes, debates, films and slide shows on scientific topics, open houses in R&D institutions, bringing out of books, special supplements in newspapers and dedicated programmes in the electronic media, seminars and symposia, special meetings and function, many field programmes and competitions for students of colleges and universities.

9th Indian Science Communication Congress (ISCC 2009)

The Focal Theme for ISCC-2009 was *"Science Meets Communication"* The 9th Indian Science Communication Congress (ISCC 2009) was organized by the K. K. Handique State Open University,

Guwahati (Assam) in association with Indian Science Writers' Association (ISWA) at Guwahati during 20-24 December 2009. Over 200 researchers and practitioners of S&T communication participated in the Congress.

Indian Journal of Science Communication

The Indian Science Communication Society continued publications of a half yearly international research journal on science communication in Hindi and English under the title 'Indian Journal of Science Communication (IJSC)'. The IJSC has an international advisory board and peer review system and disseminated worldwide. It also offers open access edition on the internet www.iscos.org

National Teachers' Science Congress (NTSC)

A national platform was created for teachers working in science education by NCSTC in 2003. National Teachers' Science Congress is building up into an unique platform where the problems at the grassroots are taken up for study as a curricular exercise. The 5th National Teacher' Science Congress was organized at Regional Institute of Education Bhubaneshwar. About 250 papers were selected for presentation.

Low Cost/No Cost Doable Experiments

A brainstorming workshop was organised during 10-12 December 2009, at Tamil Nadu Science & Technology Centre, Chennai, on development of a module on 100 low cost/ no cost doable experiments on life science in order to promote learning by doing concept.

SciMind India

NCSTC produces various software materials intended for mass S&T awareness, including audio-visual programmes, films, CDs, publications, etc. 'SciMind India'- a unique 27 part TV quiz based on demonstrations has been produced in 2009.

Popular Science Periodicals in Indian Languages

NCSTC has continued support for publication of popular science magazines including Nirantar Soch (Punhabi), Vaigyanik Drishtikon (Hindi), Arivukkan (Tamil). Vaigyanik Drishtikon has been supported as a fortnightly science newspaper in Hindi. The GRD Trust, Coimbatore was supported for bringing out wide spectrum a popular science monthly in English Wide Spectrum. The magazine reproduce article of lasting value from newspapers and also carries a wide range of popular science articles, features and columns. In addition, Virat Surya (Hindi, Marathi and English) and Arivial Poonga (Tamil) popular science magazines were also supported. Bigyan Jeuti (Assamese) and Vigyan Katha (Hindi) have also got encouraging support Vigyan Katha being first science fiction science magazine in the country is gaining popularity. Bachhon Ka Indradhanush, a Hindi bi-monthly also got support. The publication of science resource letter "*Srote*" continued.

Comics on Water & Sanitation

Two comics in Hindi, namely, "Dhoop Basti ki Samajh" & "Maya ki Jal Yukti", were brought out in collaboration with Surabhi Sarvshiksha Evam Kalyan Samiti, New Delhi for spreading water & sanitation literacy amongst children. A translation in five more languages is being contemplated. Translated audio versions of the same are also on the anvil. Five new stories have also been conceptualized on water literacy for children.

Teleserial "Utthan"

A 13 part teleserial "Utthan" for communicating rural technologies has been supported with CSIR on matching cost sharing for production and telecast. The telecast received overwhelming response from public with large participation in quiz programmes where winners were awarded. It has also been decided to dub it in 5 local languages for telecast on regional channels of Doordarshan.

Science Communication through Community Radio

Communicating Science through Community Radio has emerged as one of the leading programmes of NCSTC. The major projects developed and implemented over the period include "Science for Women's

Community listening to the programme

Health and Nutrition" and "Understanding Planet Earth". These projects are running in 10 Community Radio Stations across the country in the current year and many stations are being inducted. Each project has over 365 episodes of 15 minutes duration each. This project made rural women aware about different issues like Anemia, Non Communicable Diseases, Menstrual Hygiene Management, Low Birth Weight, HIV, TB etc. NCSTC has provided sustainable support to Community Radio Station in terms of content, finances and enhancing participatory programme production capacities. At each CRS, beneficiaries included listeners spread around 15 Km radius.

Challange *Chatni*

13 parts episode 'Challenge *Chatani*' - an interesting series on the technical solutions to the real life challenges and problems are being produced. This 13 part serial will be focusing on the problems confronting in our day to day life with their possible scientific and technical solutions.

Training Workshop on Science Writing and Journalism

A four days' Training Workshop on Science Writing and Journalism was organized by NCSTC, Vijnana Bharati, Pune and Yashwantrao Chavan University, Nasik on 28-31 January 2010. 45 participants representing 8 institutes and many citizens participated in this workshop. Under 9 different academic sessions, scientist, journalists and science writers shared their views.

Training Workshop on Puppetry

Over the years, Puppetry has developed into a powerful media of communication. Kainat Foundation, Kako, Bihar, and Students Welfare Society, Anantnag (J&K) have organized a number of programmes on science communication through Puppetry in their respective States to spread scientific messages using puppets on topics such as pollution, waste management, potable water, environment conservation, eradication of superstitions, climate change and energy awareness, etc.

Grameen Jagriti

To create awareness amongst the farming community on safe practices in agricultural operations and rational use of fertilizers, pesticides and other off-farm inputs, workshops are being organized for the KVK field extension officers, farmers which aim at training and creating awareness about these and other activities related to agriculture. Four such workshops are being organized by the Voluntary Institute for Community Applied Sciences, Allahabad, U.P. One State level training workshop to create awareness on improved agriculture technologies for extension functionaries of U.P. was organized during January 2010 at Allahabad Agricultural Institute, Allahabad, U.P.

Training Programme in Model Rocketry

To understand basic scientific principles like force, gravity, escape velocity, laws of motion, etc. training programmes on Model Rocketry were organized in Uttar Pradesh by VICAS, Allahabad, Tamilnadu Science & Technology Centre, Chennai and Manipur S&T Council, Imphal.

Volunteer Plus - Programme on Disaster Preparedness

To create awareness about various aspects of natural as well as man made disasters and to handle emergency conditions like fire, earthquake, floods, etc., training-cum-awareness programmes were organized for NCC, NSS programme coordinators, college students, etc. Heart Care Foundation, New Delhi organized one such workshop at Delhi, North East Institute of Science & Technology, Jorhat organized 3 phase workshops in different parts of Assam and Jidnyasa Trust, Thane, Maharashtra also organized a workshop on Disaster Management in Thane.

Explaining Science behind Miracles

The basic objective of this programme is to train resource person who can make people aware of tricks and so called miracles and save them from cheating by self styled god-men. During the workshop, the participants are exposed through demonstrations of about 100 such tricks followed by their explanations. Short duration projects from Uttar Pradesh, Bihar, Orissa, Uttrakhand, Punjab, Chandigarh Maharashtra and Madhya Pradesh were supported

Scientific Soft Toys and Stitch Crafts for Handicapped Students

The Science Association of Bengal, Kolkata organised a training workshop for various categories of handicapped students drawn from various schools of West Bengal during 2–6 December 2009 at Kolkata. The basic objectives of orgnising this workshop was to impart training to provide actual skill development amongst handicapped students on making the scientific soft toys and stitch craft products. Nearly 100 student got practical training by experts in the areas of toys & stitch craft making.

Capacity Building to Understand and Appreciate Nature

A comprehensive national programme has been evolved for training high school teachers who are the front runner in disseminating knowledge. The focus has been on developing hands on activities using low cost local resources within their own environment and accessibility to develop deeper understanding of complex natural phenomena which is mandatory to sustain the bio system in its requisite health. High school teachers belonging to various States were trained through five day workshops, Celebration of days-Bio diversity Day, Wetland Day, Energy Day, Ozone Day, etc. Seed banks and herbal gardens were established along with organization of quiz, painting competitions and rallies in schools and training of students in various aspects of biodiversity.

Understanding Weather & Climate Change

Science Centre (Gwalior), Bhopal and NCSTC has developed a kit to understand and measure different weather parameters like rain, temperature, humidity, wind velocity and direction, etc. A national workshop to train resource persons, NGOs, activists in understanding weather and climate change was organized at Nagpur. Another workshop was organized by the National Bal Bhavan, New Delhi for various Bal Kendra member schools. Thematic posters on Global warming, Earth as a System, Oceans, Weather and Climate and Light were developed by the Vikram A. Sarabhai Community Science Centre, Ahmedabad as part of the programme. Postcard sets on the campaign theme were also developed and distributed in schools and colleges, through State S&T Councils.

National Awards for S&T Communication

Science and Technology communication is a specialized area having individuals and institutions dedicated to the cause. Outstanding efforts are recognized with national awards, annually. Following awards were given during the year: National Award for Outstanding Effort in S&T Communication through Books and Magazines to Dr. Durga Dutt Ozha, Jodhpur, and Shri Natarajan Ramadurai, Chennai; National Award for S&T Popularization among Children to Shri Takhellanbam Robindro Singh, Thoubal, Manipur; National Award for S&T Communication in Print Medium to Shri Dinesh Chandra Sharma, Rampur, U.P; National Award for S&T Communication in Electronic Media to Dr. Manas Pratim Das, 24 Paragans, West Bengal

Rajat Jayanti Vigyan Sancharak Fellowships

These fellowships were instituted in the year 2007 on the occasion of silver jubilee celebrations of National Council for Science & Technology Communication. The Fellowships are awarded to young Science Communicators with uniformly brilliant academic record and field work. It also supports innovative Science Communication efforts in selected scientific institutions/universities/S&T based voluntary organizations under the guidance of a senior science communicator. Nine candidates in the year 2009 were awarded fellowships. The duration of the fellowship is for one year and comprises honorarium of Rs.12,000/- per month (16000/- in case of a Ph.D.), an annual contingency of Rs. 30,000/- and travel grant of Rs. 15,000/-. Mentors will receive Rs.20,000/- in a year.

UNESCO Kalinga Award for Popularisation of Science.

The UNESCO Kalinga Prize for Popularisation of Science is an international award administered by UNESCO presented to candidate who has a brilliant career as writer, editor, lecturer, film producer, radio/television programme director or presenter. The laureate is selected by the Director General, UNESCO,

Paris. So far 65 candidates from 22 countries have been awarded the prize. Out of these, seven awardees are Noble Laureates.

The award for the year 2009 has been conferred on Prof. Yash Pal, Chancellor, JNU, New Delhi and Prof. Trinh X. Thuan, Department of Astronomy, USA for their invaluable contributions in communicating science to people. The prize included 10,000 Pound Sterling with the contribution of Government of India, Kalinga Foundation Trust and Government of Orissa and a Citation. Government of India has introduced Kalinga Chair to mark the 50th Anniversary of the Kalinga Prize. The winner is invited to deliver lectures on Science Communication to various target groups, for a period of two to four weeks as a guest of the Government of India. The Chair comprises a token honorarium of US $5000.

NATIONAL SCIENCE AND TECHNOLOGY MANAGEMENT INFORMATION SYSTEM (NSTMIS)

The National Science & Technology Management Information System (NSTMIS) division continued its efforts of generating and making available information on both manpower as well as financial resources devoted to scientific and technological (S&T) activi-ties by conducting national surveys both through in-house as well as sponsored studies.

S&T Resources Studies

The next national survey for collection of data on resources devoted to research and development (R&D) activities for the year 2009-10 is being launched. The questionnaires for launching the survey have been prepared. For online submission of the data, e-questionnaires have also been designed keeping in view the parameters to be covered in this survey and these are also being made available to the S&T agencies and other data providers. To facilitate online submission of e-questionnaires, problems faced by respondents during the previous survey (2005-06) have been thoroughly studied and necessary improvements have been carried out in the software. For this survey also, as in the previous case, both hard copy as well as electronic questionnaires are being sent to overcome the teething problems faced by respondents while switching over from hard copy to electronic filling of questionnaires.

The national level report based on the above mentioned survey 'Research and Development Statistics 2009-10' will pro-vide information and analysis in forms and variety like financial and human resources deployed by research institutions/ laborato-ries of major scientific agencies, central ministries/ depart-ments, State Government institutions/ departments, research stations and in-house R&D units of public and private sector industries. Apart from this, the publication will also give information on patents, enrolment, out-turn, stock of S&T person-nel, Plan/Non-Plan allocation for S&T, stock of scientists, engineers, technicians for selected countries, and R&D expendi-ture per capita and as percentage of gross national product, etc.

Work to bring out another publication of NSTMIS division entitled 'Directory of R&D Institutions' has been completed. The present Directory is ninth in the series containing list of around 4700 R&D institutions with complete addresses arranged alphabetically within the sectors to which they belong. Details on various communications modes such as phone, fax, e-mail, website addresses have also been given, wherever possible. Care has been taken to provide accurate information on R&D institutions located throughout the length and breadth of the country. The scope and coverage of the present edition of the Directory has been enlarged by adding addresses of additional industries registered with the Department of Company Law Affairs. The directory is presently under print.

To align with the changing paradigm centered on innovation, the NSTMIS has evolved a new initiative 'Science Technology Innovation and Creation of Knowledge (STICK)'. The National Innovation Survey framework finalised by the division after in-depth discussion with the national/ international experts, shall be used in the implementation of the STICK programme. STICK is aimed at a) developing innovation indicators to understand the dynamics of innovation and knowledge creation activities and its relation with economic growth and b) benchmarking the national performance of the innovation system. This will provide policy actions, appropriate incentive structures, international comparisons for planning and fostering the innovation eco-system of the country. The programme will be launched in the forthcoming year 2010-11.

Information System/Database Activities

With a view to disseminate information on research and development (R&D) projects for the benefit of different interest groups, the NSTMIS Division of DST continued its effort to compile information on extramural R&D projects funded by different central S&T agencies. Besides maintaining a computerised database on extramural R&D projects from 1985-86 onwards, the Department publishes annually a directory of extramural R&D projects funded during the year. The two directories for the years 2006-07 and 2007-08 were brought out this year.

The directory for the year 2007-08, eighteenth in the series, contains information on 3515 new R&D projects approved by 17 central government departments/ agencies. The total approved cost of these projects was Rs.1467.19 crores. Projects in the Engineering & Technology area received maximum financial support (32.21%) followed by Biological Sciences (23.04%) and together these received about 55% of the total R&D sup-port. Fifty one percent (51%) of the total support was given to the academic sector comprising of universities, deemed universities and institutes of national importance. The National Laboratories under government received 25% of the total financial support. Among the funding agencies, the extramural R&D support by Department of Science & Technology (DST) was the highest with Rs.695.87 crores followed by Department of Biotechnology (DBT) with Rs.302.65 crores.

Sponsored Studies

Apart from the in-house efforts in bringing out the R&D statistics at national level, the division sponsored several studies to build databases on S&T investment, S&T manpower availability/ deployment/ gap and S&T indicators.

The following studies were completed during the year:

i) Expert system for Indian Woods – their Microstructure, identification, properties information and uses.

ii) Creation of Expert's Directory of Life Sciences in India.

iii) Animal Diseases and Veterinary Care Systems.

iv) Impact of Foreign collaboration on Indian Industry.

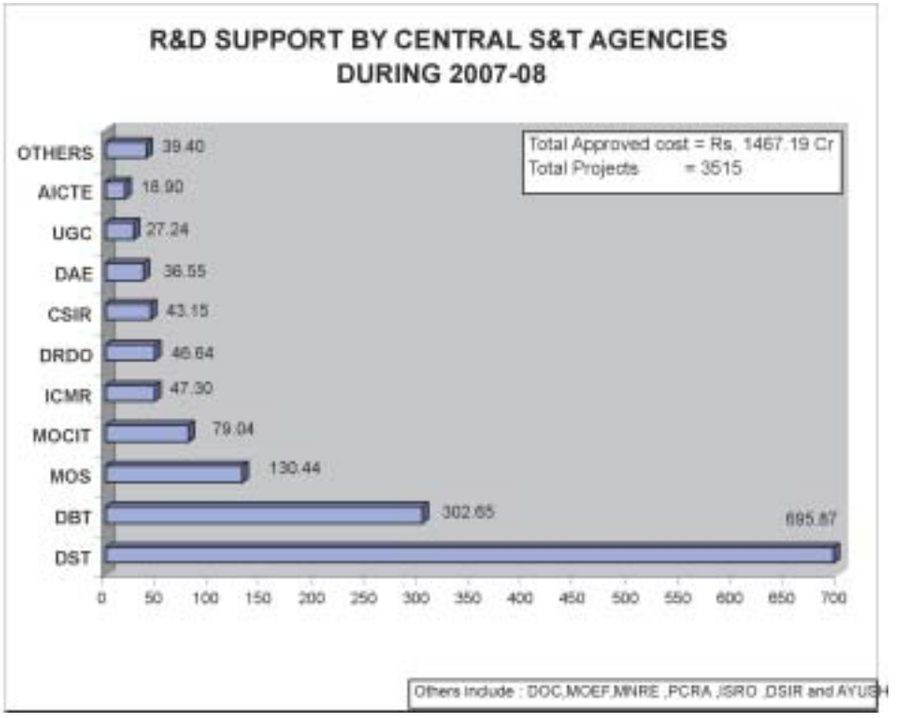
v) Profile of Indian Scientists in Major Scientific Agencies.

vi) Study of Bottlenecks in industry, Academic and Institution Linkage in Pharmaceutical sector and development of database for Academia-Industry Partnership Promotion.

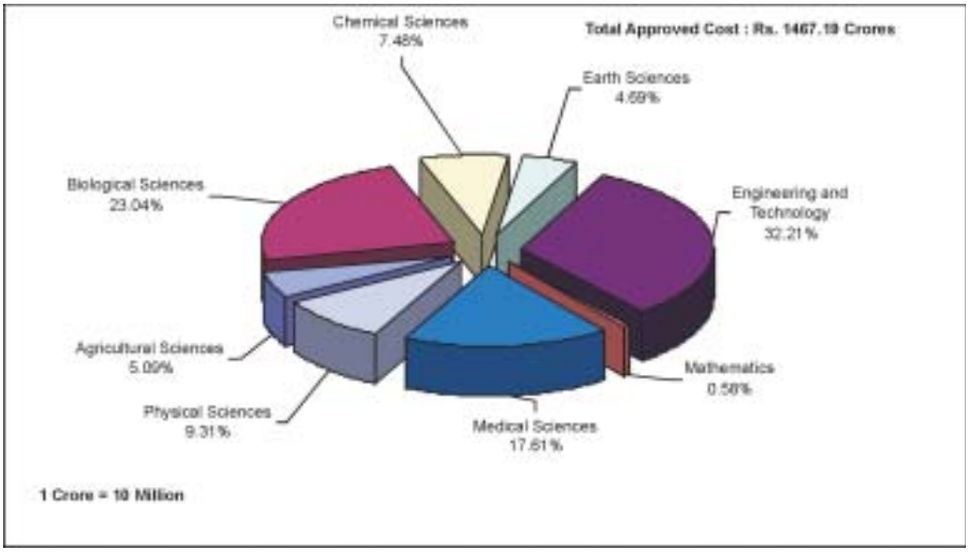
vii) Profile of R&D Manpower in various industrial sectors.

International Collaboration

The Department has actively participated and contributed in the development and revision of standards/ concepts/ definitions used for collection of Science Statistics and development of Science & Technology Indicators in UNESCO Institute of Statistics (UIS) and Organization for Economic Cooperation and Development (OECD) meetings. The department also provided information for the country on Science & Technology indicators to UNESCO Institute for Statistics for their publication titled "UIS Statistical year book".



SUBJECT AREA-WISE R&D SUPPORT DURING 2007-08



STATE SCIENCE & TECHNOLOGY PROGRAMME

The Department played a proactive role by facilitating the State Governments in establishing and developing the State Councils on S&T and by providing support for their technical secretariats. Concurrently DST, in collaboration with respective State Councils, organized all India thematic seminars/ workshops whose recommendations helped identify some activity-areas for promotion by the State Councils. DST also organised periodic review meetings to discuss the status of various S&T programmes and to plan the strategy for future. Regional Meetings organised by DST facilitated review of State S&T structures and identification of areas of mutual cooperation.

A Decennial Review was held in July 1992 to assess the strengths and weaknesses of this programme vis-à-vis DST's performance. It emphasized on significant increase in programmatic support to the State S&T Councils and strengthening linkages between these and Central S&T Agencies by suitably dovetailing various programmes. It was also realised that these State S&T Councils, since their formation had come of age to initiate a phase where resources in terms of expertise and technology promoted and generated by the Central and State S&T Agencies be pooled together to undertake joint programmes. Sequel to decennial review, Programmatic Support under the scheme to accelerate S&T activities at the State level was undertaken so as to ensure integration of S&T for overall socio–economic development with special emphasis on location specific research & technology development, adaptation and transfer, S&T studies/ surveys and information exchange & experience sharing on specific S&T programmes.

During the year following activities were carried out to expand the horizons of the programme so that particularly the rural community may be benefitted:

Two meetings of Project evaluation Group were held and 63 new proposals were discussed in these meetings. DST also organized Group monitoring meeting to monitor 23 ongoing projects progress as well as assess the result the completed project. The Department also organized several expert committee visits to various State Councils for review of their activities. The new Project evaluation Group has been constituted for implementation of the programme in focused area.

Some of the important achievements during the year under various activity heads of the programme are as follows:

Core Support to State S&T Councils

Core support is being provided to State S&T Councils with the objective of facilitating State S&T Councils in planning, monitoring and implementing S&T activities in the State. The core support includes support for S&T manpower in addition to travel, office expenses and to modernize office equipment. This support is intended to develop and nurture S&T capabilities required for development of the state through S&T intervention and has to be specifically oriented to the felt needs of the State and facilitate operation of the Council as modern office responsive to the needs of scientific community and other stakeholders within the State. During this year, core support has been provided by DST to 25 S&T Councils in States which also include one Union Territory (UT).

Support to Patent Information Centers (PIC)

Considering the need for disseminating knowledge on patents and spreading its awareness in the country, the Department facilitated in establishing Patent Information Centres in different State S&T Councils since 1997. These PIC's help in patent searches, guide the inventors for patenting, establish patent nodal

cells in universities of the States, and so on. Nearly 20 such centers have already been established in the country. The Department has provided funding support to the 8 PIC's of the States Councils of Mizoram, West Bengal, Punjab, Uttar Pradesh, Tripura, Sikkim, Assam and Kerala which also include establishment of new Patent Information Centre (PIC) at Mizoram State Council of S&T, Aizwal during this year.

Demonstration Projects including Replication of Successful Models

Under this scheme a core group has been working which is providing guidance for the demonstration of technologies developed at national laboratories, State Councils, NGO's and Universities. Some of the major achievement of the this year are as follows:

Water purification technology

One defluoridation plant of 4000 LPH capacity was installed at Hindustan College of Science & Technology (HCST) campus, Farah, Mathura.

Low Energy Membrane Desalination & Deflouridation plant installed at HCST Campus, Farah , Mathura

Iron Removal Plant : The 5000 LPD based on membrane technology developed by Central Glass and Ceramic Research Institute, Kolkata installed at Sikkim Science Centre Gangtok

Agribusiness promotion: Agribusiness Promotion through technology demonostration in Renwai region (District Uttarkashi) Uttarakhand is being taken up. A tissue culture facility has been set up and in-vitro propagation of early and dwarf varieties of walnut as well as chrysanthemum is being undertaken.

Tissue culture facility at Renwai Region, Uttrakhand

Organic farming project at Sikkim

DST has initiated an Organic Agriculture Programme based on Scientific Inputs in Sikkim state in collaboration with MR Murarka GDC Rural Research foundation, Jaipur to provide agro advisory and minimize the use of pesticides so that good nutrition value in the vegetables / crops may be achieved .

(Organic farm of Tomatoes established at Kokley Village of Sikkim)

Some of the new projects were initiated on "Demonstration and popularization of value addition and processing of Garlic in production catchments", "Technology Demonstration of biogas enrichment and bottling system for rural energy security", "Kedarnath-II Mini Hydro power project (2*100 KW) at district Rudraprayag, Uttarakhand".

Location Specific R&D and Technology Development

New projects were initiated on: "Development and commercialization of traditional KUM as herbal hair dye", " Potential and prospects of Algae and aquatic plant pigments of lake Chilka (Berhampur) for industrial application", "Survey and identification of wasteland- farmers participatory approach for prospective converting into productive land", "Studies on the emerging diseases and traditional medicinal practices in Indira Gandhi Nahar Pariyojna (IGNP) of Western Rajasthan", "Estimation of pesticides and heavy metals in people of Bihar and linkage with Cancer" , "Study project of Nagaland to initiate Organic Agriculture Programme based on Scientific Inputs", "Impact of water quality on hypoheric biodiversity in the selected tributaries of Ganga and Yamuna rivers of Doon Valley, Uttrakhand, " Implementation oriented parcel-wise database creation on S&T needs for development of fishery and sericulture sector on most backward districts, West Bengal", "Bioremediation of contaminated soils in different agro-ecological zones of Tmail Nadu", "Bio-prospecting of plant fibres", "Integration of botanical pesticides and entomopathogenic fungi for the control of mosquito vector at different agro climatic regions of Tamil Nadu".

The projects on "Extension and technology demonstration for in-vitro clonal multiplication of Bamboo and Shisham and their establishment in the Uttar Pradesh", "Survey Collection and analysis of Oil, Protein and Fatty acid profile from seeds of different species of Acacia (Babul) distributed in Rajasthan to be used as biofuel" were completed

Joint Study / Surveys / Programmes

a) 32nd Series "Student Project Programme cum Exhibition**"** for final year Engineering students was organized in collaboration with Karnataka State Council of S&T, Bangalore.

b) 4th Uttarakhand State Science & Technology Congress (USSTC) wasorganized during 10-12 November 2009 in collaboration Uttarakhand State Science & Technology Council, Dehradun.

c) 5th J&K Science Congress organized during 9 -11 Feb 2010 in collaboration with J&K State Council of Science & Technology, Jammu.

d) 22nd Kerala Science Congress organized in collaboration of the Kerala State Council for Science, Technology & Environment, Thiruvananthapuram during 29-31 January 2010.

e) A National Seminar on "Role of women in combating climate change" supported at Kerala State Council for Science, Technology & Environment, Thiruvananthapuram.

f) Awareness programme on 'Pesticides Monitoring in Seasonal Vegetable and Soil of Agra District' was organized at Hindustan College of Science & Technology, Farah, Mathura on 8 March 2010.

g) Organization of State Level Science Exhibition for motivating basic science among students and public supported at Yadava College, Madurai.

h) Brain Storming Session of Scientific Advisory Council to PM (SAC to PM) with State Science & Technologies Councils is planned at Indian National Science Academy (INSA), New Delhi on 27 March 2010.

MISSION ON NANO SCIENCE & TECHNOLOGY

The Mission on Nano Science and Technology (Nano Mission)- an umbrella programme- was launched in May 2007 to promote R&D in this emerging and highly competitive area of research in a comprehensive fashion. The main objectives of the Nano Mission are basic research promotion, infrastructure development for carrying out front-ranking research, development of nano technologies and their applications, human resource development and international collaborations. In 2009-10, Nano Mission recorded significant expansion in its activities and also continued to break new grounds in promotion of R&D in this field of research.

Calibration runs were carried out with the India-Japan beamline at the Photon Factory, KEK, Tsukuba, Japan on way to its establishment and commissioning for wider use. This project was sanctioned last year. The data gathered during calibration runs was very promising and reassuring. The beamline is expected to be functional by mid-2010.

For getting access to all the beamlines at the PETRA-III Synchrotron Radiation Facility and FLASH facility at DESY, Hamburg, Germany, a Detailed Project Report (DPR) was prepared during the year. This facility is also expected to become available to the Indian scientists next year. PETRA-III being a high-energy X-ray source with nanosized beams, its availability will be of special significance for nanoscience research in the country.

A comprehensive plan to launch applied nanotechnology oriented projects with industry participation was worked out. The programme is expected to be launched by mid-2010.

The biennial International Conference on Nano Science and Technology (ICONSAT- 2010) was organized at IIT-Bombay, Mumbai and it was attended by over 700 delegates from across the world. Over 1100 abstracts were received for this Conference and only the best could be accommodated. That showed the increased scientific standing of this activity at the international level. This Conference was also attended by large number of research students who showcased their research through posters.

The 4th National Research Award in Nano Science and Technology was awarded to Prof. Pushan Ayyub of the Tata Institute for Fundamental Research, Mumbai during ICONSAT-2010.

The Institute of Nano Science and Technology at Mohali (INST-Mohali) got registered as an autonomous society during the year. This institute would focus on research in the areas of agri- and bio-nanotechnologies. Temporary accommodation has been leased to start the activities of the institute.

M. Tech. in Nano Science and Technology was supported in one more institute, viz. the Jawaharlal Nehru Technological University (JNTU), Hyderabad, during the year, thereby raising the total number of institutions running PG programmes to fifteen.

33 new R&D projects were funded this year which aimed at investigating fundamental scientific aspects of nano-scale systems. As expected, these projects spanned a wide variety of subjects like growth and characterization of Gallium Nitride and related alloy heterostructures, synthesis & characterization of hybrid polypropylene-montmorillonite-wood fibre nanocomposites, development of nanodielectric polymeric material for industrial applications, controlled drug delivery using layer-by-layer self assembly on magnetic PLGA nanoparticles using dual drug regime for breast cancer therapy, etc.

Large number of very good publications have come out of the ongoing R&D projects and the Units and Centres supported so far. Significant scientific results reported from these projects are as follows:

- Work is in progress on functional nanomaterials for solar cells and other opto-electronic applications. Investigations have been done on metal oxide nanoparticle based dye sensitized solar cells and visible light photo catalysts.
- Studies on nanocrystal formation from amorphous phase in Zn and Fe based alloys concluded that the constituents of micro structure with magnetic nature of phases and nature of interfaces between crystalline and amorphous phases dictated the overall magnetic properties of these novel nanocrystalline materials.
- Studies havealso been carried out to study the influence of doping on the structural and photoelectronic properties of Indium-doped ZnO (IZO) thin films deposited by sol-gel technique. IZO thin film is an attractive material for transport electrode in Schottky barriers, photo-detectors and thin films solar cells.
- Work on hydrothermal synthesis of TiO_2 nanoribbons and its application in photo-electrochemical splitting of water for hydrogen production is under progress.
- Detailed Microwave absorption studies carried out on nanocomposite films made of silver nanoparticles embedded with poly-vinyl-alcohol has showed that these films exhibited appreciable microwave absorption in the 8-12 GHz range.

Significant progress had also been made in the ongoing joint institute-industry linked projects. In a project on nanocomposites for tyre applications, nanoclay has been used as fillers. The clay used was modified montmorillonite clay. The nanocomposites were analyzed by a number of techniques. Among the new observations was exfoliation of the rubber nanocomposites when the curing temperature was maintained at 191ÚC. The exfoliated structures have shown high gas permeability. In a project on nano fibres and textiles, significant progress has been made on encapsulated phase change materials for thermo-regulated smart textiles, textile nanofinishes and production of nanofibre web by electrospinning for filtration applications. Auto filters based on nanofibre-based filtration media are under industrial trials. In another project, an electrochemical nanofabrication facility has been set up for preparing TiO_2 nanotubes and ZnO nanorods of different aspect ratios. These materials are important because of their use in photovoltaic devices. Dye Sensitized Solar Cells (DSSC) have also been fabricated and characterized.

MEGA FACILITIES FOR BASIC RESEARCH

The Mega Facilities for Basic Research programme was launched to either build large research facilities in the country or to participate in building and using such facilities abroad to answer some of the most fundamental and significant scientific questions in contemporary science. The nature and scale of such facilities make them manifestly multi-agency, multi-institutional and, quite often, international in character. The other distinguishing feature of these facilities is that they are extremely long-term projects.

India's active participation in experimental programmes at CERN, Geneva continued during the year. Projects were funded, jointly with the Department of Atomic Energy, for taking part in the CMS (Compact Muon Solenoid), ALICE (A Large Ion Collider Experiment) experiments at CERN and in the establishment of the LHC (Large Hadron Collider) Computing Grid.

Significant progress was made in defining India's participation in the FAIR (Facility for Antiproton and Ion Research) project at Darmstadt in Germany. The R&D and prototyping work advanced for the magnet components and some components of the CBM (Compressed Baryonic Matter) detector. Items for in-kind contribution to the PANDA (Antiproton Annihilations at Darmstadt) and NuSTAR (Nuclear Structure, Astrophysics and Reactions with Rare-Isotope-Beams) experiments were also identified. Following the special efforts by DST and DAE, the Electronics Corporation of India also joined this collaboration. They identified power converters as their in-kind contribution.

Projects for detector R&D and prototyping for the India-Based Neutrino Observatory (INO) were formulated by several university groups and submitted for financial support. A project for setting up a twin beam line at the Elettra Synchrotron Facility at Trieste, Italy for macromolecular crystallography and high pressure physics was submitted for financial support. A Detailed Project Report for India's participation in a Giant Segmented Mirror Telescope project abroad was also formulated and submitted. Evaluation of the same is in progress.

NATIONAL GOOD LABORATORY PRACTICE PROGRAMME

Governments and industries all over the world are concerned about safety of humans, animals and the environment through use of chemicals (industrial chemicals, pharmaceuticals, veterinary drugs, pesticides, cosmetic products, food additives, feed additives, etc.). Regulatory authorities, the world-over, are continuously engaged in determining the level of risks acceptable to the society and elaborate on scientific inputs and technical data to ensure that risks posed by these chemicals do not exceed the contemplated level of risks.

Good Laboratory Practice (GLP) is a quality system, which has been evolved by the member countries of Organization for Economic Co-operation and Development (OECD), concerned with the organizational process and conditions under which non-clinical health and environmental safety studies on the above-said chemicals are planned, performed, monitored, recorded, reported and archived. This system helps to ensure the quality and integrity of safety data (on chemicals) produced by test facilities. The OECD Principles of GLP are internationally accepted.

A National Good Laboratory Practice (GLP) Compliance Monitoring Authority was set up in April 2002, under the administrative control of DST, with the approval of the Cabinet to help Indian industries to obtain GLP-compliance status for their test facilities, so that data generated by these test facilities is acceptable in the countries of OECD. India, at present, enjoys the status of a Provisional Member of the OECD for the purpose of GLP, and this membership will end in April, 2012.

Some of the major achievements of the Indian GLP programme are as follows:

- Two new test facilities were granted the GLP-compliance status. These include:
  a) NIPER, Mohali
  b) Himalaya Drug Company, Bangalore
- One new test facility was re-certified:
  a) Zydus Research Centre, Ahmedabad
- Annual Surveillance inspection of following test facilities was done and their GLP-compliance status was continued for a period of another year :

a) IIBAT, Padappai

b) Jai Resarch Foundation, Vapi

c) Dr. Reddy's Laboratories Limited, Hyderabad

d) Gharda Chemicals Limited, Dombivili

e) Orchid Chemicals and Pharmaceuticals Limited, Chennai

f) Advinus Therapeutics Private Limited, Bangalore

g) Ranbaxy Research Laboratories, Gurgaon

h) Intox Private Limited, Pune

i) Laboratory Animal Research Services, Reliance Life Sciences Private Limited, Navi Mumbai

j) Shriram Institute for Industrial Research, Delhi

- The following training course/ workshop/ symposium were organized and supported by NGCMA, DST in 2009-10 :-

  a) Sensitizing Workshop on GLP at INSA, New Delhi on 24 July 2009.

  b) Brainstorming for GLP Inspectors at INSA, New Delhi on 11 September 2009.

  c) A project on Developing GLP standards on Bio-Medical Devices initiated at Sree Chitra Tirunal Institute of Medical Sciences and Technology, Thiruvananthapuram**.**

  d) One day Pre-Conference Workshop on "Pre-clinical toxicology and ethics in animal experimentation and GLP" on 4 November 2009 at NIN, Hyderabad**.**

- OECD carried out the evaluation of the Indian GLP Programme through their Mutual Joint Visit (MJV) during 14-18 February 2010. The MJV team consisted of experts from the GLP authorities of Australia and UK.

- Two Indian Inspectors attended the 9th OECD GLP Training Course at Bassel, Switzerland.

- The website of National GLP Programme **"www.indiaglp.gov.in"** has been re-designed and is continuously being updated.

CLIMATE CHANGE PROGRAMME

Under the aegis of the National Action Plan on Climate Change (NAPCC), the Department of Science & Technology, Ministry of Science & Technology has been entrusted with the responsibility of coordinating two National Missions on Climate Change. These are (a) National Mission on Sustaining Himalayan Ecosystem and (b) National Mission on Strategic Knowledge for Climate Change.

The National Mission on Sustaining Himalayan Ecosystem (NMSHE) proposes to work towards initiating research & development in the relevant areas, taking up appropriate policy measures and time bound action programmes to address sustenance and ecological resilience of the Himalayan region and ensure the continued provision of key ecosystem services.

The National Mission on Strategic Knowledge for Climate Change (NMSKCC) seeks to build a vibrant and dynamic knowledge system that would inform and support national action for responding effectively to the objective of ecologically sustainable development.

Both the Mission documents have been accorded in-principle approval by the PM's Council on Climate Change. As per Council's directives, the Mission documents are being further revised and updated. The actions for obtaining necessary administrative and financial approvals for implementation of the two missions have been initiated.

Attempts are being made to bring the experts, institutions and research & scientific communities at a common platform to share their experience and expertise in the key areas of Climate Change. In this regard, a national level Brainstorming meeting was organized on "Himalayan Climate and Glaciers" at IIT Delhi on 15-16February 2010. Over 70 scientists, experts and students from about 25 institutions across the country participated in the meeting. Several short and long term recommendations emerged for further implementation under the NMSHE mission.

Efforts are also being made to identify the knowledge institutions engaged in R&D development and capacity building relating to above missions.

NATIONAL MISSION ON BAMBOO APPLICATIONS

The objectives of the National Mission on Bamboo Applications (NMBA) are: (i) development and induction of technologies and value adding processes in the bamboo sector for its sustainable industrialization (ii) income and employment generation in rural/ backward areas in bamboo resource regions (iii) support for growth of bamboo industries.

Sustained support to bamboo housing and structures

(i) With NMBA support 20 projects aggregating Rs.5.9 crores were completed with counter-part contribution of Rs.4.7 crores which is nearly 80% of the project cost.

(ii) National Institute of Fashion Technology campus infrastructure was implemented at Kangra (HP)

(iii) Bamboo classrooms & utilities were erected in about ten colleges attached to Delhi University.

(iv) A new project has been approved for implementation in Arunachal Pradesh to manufacture new jointing technology products developed in Germany.

(v) Two bamboo timber industrial projects have been approved to facilitate indigenous production of bamboo timber and strand boards, one each in Mizoram and Maharashtra.

New initiatives and ideas

(i) 1600 bamboo poly houses have been successfully implemented in Sikkim.

(ii) Setting up of 1000 bamboo poly houses with Indian patented technology in Himachal Pradesh has been approved.

(iii) Setting up ten Centres for Bamboo Training and Product Development in joint or PPP mode has been approved. The Centres have begun operations in Gujarat and Maharashtra. Centres have been sanctioned in Chattisgarh and Orissa.

(iv) An international cooperation project with INBAR for design and standardization of bamboo connection technology for whole bamboo structures has been approved. It involves a sustained training component.

(v) Import of German technology (for bamboo jointing) to set up a commercial Export oriented Unit in Arunachal Pradesh.

(vi) The concept of industrial bamboo plantation for captive use in bamboo industry is being incorporated.

(vii) Research and development project sanctioned for use of bamboo plastic and bamboo composites in the proposed car-taxi project in Delhi (collaboration with Argentum Motors)

(viii) Best display award for bamboo pavilion during India International Trade Fair 2009.

(ix) Three bamboo stores in Delhi, Mumbai and Ahmedabad

(ix) Nine promotional films in bamboo released on NET and DVD.

(x) A website has been developed for marketing of bamboo industrial roducts.

Research projects

A total of 11 research projects were sanctioned with a total outlay of Rs.2.5 crores including:

(i) Use of bamboo as Nano Whisker

(ii) Use of bamboo plastic and bamboo composites in car-taxi projects

(iii) Double storey bamboo buildings: structural design and documentation study has been undertaken with Jadavpur University, West Bengal.

(iv) Studies on economic value addition in various bamboo industry sectors have been undertaken.

(v) CDM (Clean Development Mechanism) study in bamboo structures, gasification and charcoal sectors has been initiated to tap the potential of Bamboo in the present context of climate change.

(vi) Eco-friendly resin project study has been undertaken with IIT, Delhi for the bamboo board and flooring industry.

Sanction of new bamboo industrial units

(i) A total of 34 projects were approved at a total investment of Rs.46 crores, out of which private investment generation will be Rs.25 crores.

(ii) A bamboo energy project of 1.2 MW has been sanctioned in Madhya Pradesh with a project cost of Rs.5.2 crores which is based on bamboo gasification.

(iii) Two new, ambitious bamboo timber projects (total project cost Rs.29 crores for both; NMBA contribution Rs. 10 crores) for manufacture of bamboo timber and strand boards have been approved.

INNOVATION CLUSTERS

The scheme aims to create globally competitive research and technology base for cluster development at the community level and fostering technology leadership through cluster champions and knowledge-based strategies. The scheme also aims to develop cognitive science cluster for carrying out research in this specialised domain.

Learning from the past work, need was felt to focus on more knowledge intensive clusters with higher scope for innovation. Accordingly, an ICT cluster in the National Capital Region of Delhi and two Life Sciences clusters at Ahmedabad and Hyderabad were selected for targeted interventions. Drawing from the promising outcomes of interventions at Samalkha foundry cluster, it was decided to retain and expand the scope of interventions in the nearby two foundry clusters of Haryana. Achievements in these clusters during 2009-10 are as follows:

- Mapping of all relevant stakeholders in the ICT cluster of NCR region of Delhi is being done. A suitable action plan is being drawn to foster innovation and implement it to ensure that at least 5 innovations are supported. Besides, at least 5 networks/ institutions or forums would be supported or created to enhance their focus of activities towards innovation
- Mapping of stakeholders among Life Science clusters of Ahmedabad and Hyderabad too is being done, action plan drawn and activities to strengthen the local eco-systems launched. At least 4 innovations are to be supported among different product and service categories.
- Potential gains on bundling of carbon credits will have been ascertained due to technology up-gradations in Samalkha and adjoining foundry clusters. For the first time 40 enterprises out of a projected 200 enterprises have agreed to join hands for collective bundling of 280,000 potential carbon credits over next 10 years. At least another 40 foundry enterprises among 3 foundry clusters will adopt up-graded technology and practices leading to a saving of another 1500 MTs of coke per annum and 3,750 MTs of carbon di-oxide reduction per annum.
- Mutually beneficial linkages with ITI Panipat are being established to develop a modern mini Foundry and to ensure availability of skilled human resources for the cluster.
- Market assessment (Domestic and export) for chaff cutters is being undertaken and at least 2 prototypes of chaff cutters and sugar cane crushers will be developed.

Under Cognitive Science Research Initiative, Department provides support for basic science, infrastructure development and human resource development. In addition to this, Department has initiated a new programme of 'Post Doctoral Fellowship' in Cognitive Science from this year to encourage young researchers to pursue research and make career in this emerging field. This year Department has received 24 applications for consideration.

Department is developing two major interdisciplinary programmes under top-down approach, one on 'language and cognition' with 27 PIs and the second on 'cognitive networks' with 12 PIs. The first project 'Language and brain organization in normative multilingualism' addresses the relationship between language and cognition as human capacity with a special emphasis on the linguistic and cognitive diversity of India. The other coordinated project on 'Generativity in cognitive networks' deals with the study of manner in which mental functions emerge from interconnected neural architectures and focused on the integration of mental functions like emotion, thought and social cognition as well as the evolution of these functions across evolutionary time. Both projects have been sanctioned by the Department.

GENDER INITIATIVES

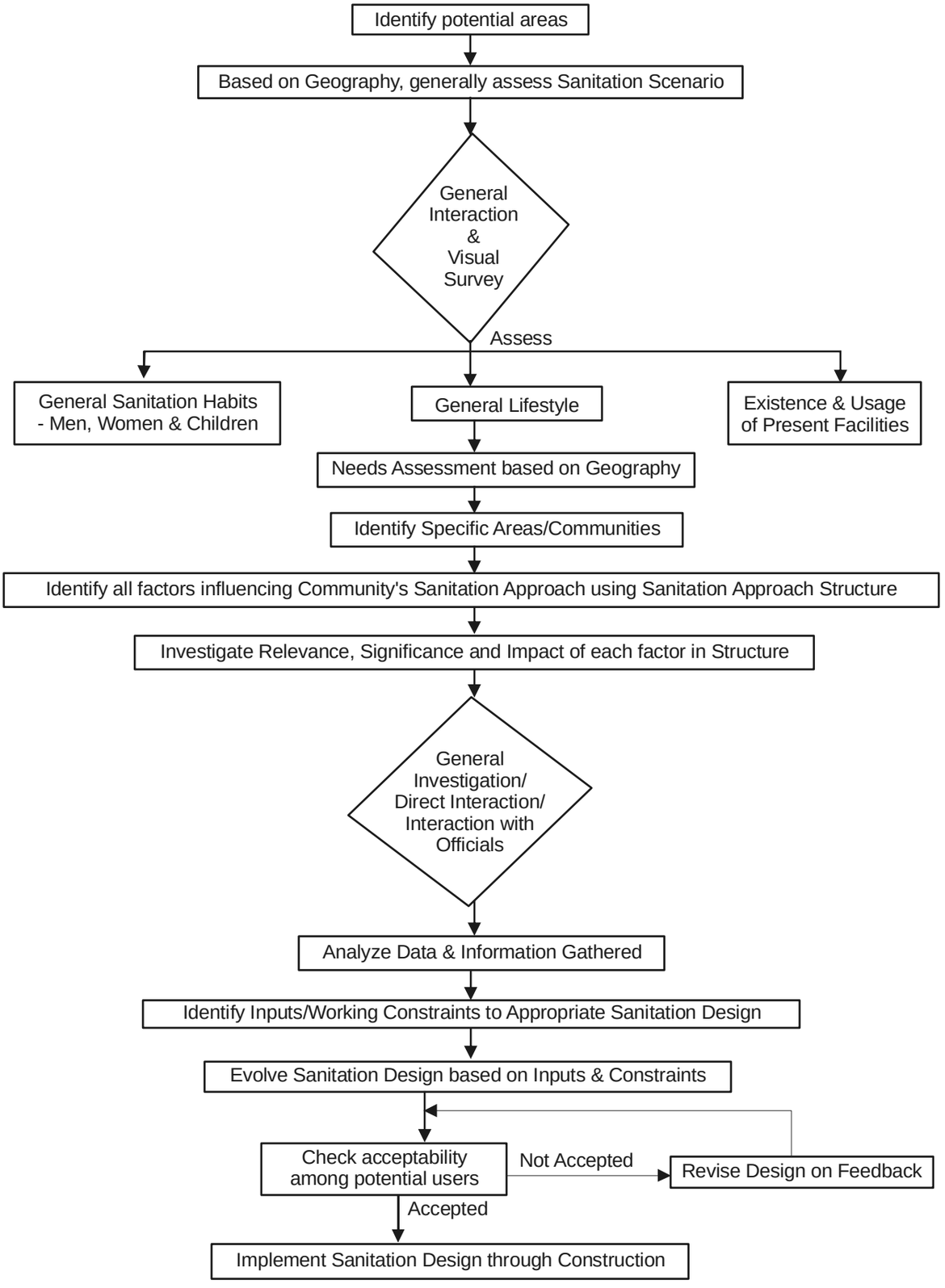
Science & Technology for Women

The Science and Technology for Women scheme of the Science for Equity, Empowerment and Development (SEED) Division aims to promote research, development and adaptation of technology to enhance the overall social status of women and augment their contribution S&T development, especially in rural areas. Priority areas, with women as specific target groups, have been identified for proper scientific/ technical interventions in the existing methodologies for empowerment and sustainable livelihood. Coordinated Programmes (AICP's) have been launched in select technology areas to provide a platform for spread of successful technology packages to remote parts of the country. The focus of these S&T interventions has been various aspects relating to agriculture (including post harvesting techniques used by women) horticulture, sericulture, aquaculture, indigenous health practices, cultivation of medicinal plants, aromatic grasses, occupational hazards, etc. The following are some of the programmes taken up under the present component:

- Under a project sustainable livelihood options for rural women focus has been on utilization of underexploited crop plants in Thrissur district of Kerala covering seven Panchayaths. The project has been conceived and planned with an integrated approach using inputs of agronomy, processing technology and extension. The facilities at the Radio Tracer Laboratory under the Kerala Agricultural University have been utilized for analyzing the nutrient contents of the plants. The selected leafy plants, viz., *Boerhaavia diffusa*, *Cassia tora*, *Centella asiatica*, *Curcuma amada* and *Alternanthera sessilis* have been planted in both controlled conditions and in the farmers' field as intercrops in coconut.

Intercropped situation for sustainable livelihood options: Growing Leafy Plants as intercrops with coconut.

- Himachal Pradesh is an agrarian State and most of its population depends upon agriculture and allied activities like horticulture and cattle rearing. However, due to over exploitation, agriculture and related activities have become less lucrative in terms of economic returns. Rejuvenation of soil requires


Identify potential areas
Based on Geography, generally assess Sanitation Scenario
General Interaction & Visual Survey
Assess
General Sanitation Habits - Men, Women & Children
General Lifestyle
Existence & Usage of Present Facilities
Needs Assessment based on Geography
Identify Specific Areas/Communities
Identify all factors influencing Community's Sanitation Approach using Sanitation Approach Structure
Investigate Relevance, Significance and Impact of each factor in Structure
General Investigation/ Direct Interaction/ Interaction with Officials
Analyze Data & Information Gathered
Identify Inputs/Working Constraints to Appropriate Sanitation Design
Evolve Sanitation Design based on Inputs & Constraints
Check acceptability among potential users
Not Accepted
Revise Design on Feedback
Accepted
Implement Sanitation Design through Construction

extensive usage of animal excreta and composting of biomass; these require promotion of cattle rearing on a larger scale. To extend these activities on wider scale in the State, a project has been implemented covering 500 women in 8 blocks of five districts. The objective being to achieve quality milk production and availability of animal excreta for bioremediation of agriculture soil. The silage making technology also demonstrated among the beneficiaries of 3 blocks depending upon the availability of green fodder after rainy season. Large scale demonstration of silage making using waste from the maize crop and cabbage was demonstrated among the beneficiaries and silage demonstration were taken up using waste of the maize crop and cabbage.

- Technology packages for total rural sanitation for women in coastal and semi-arid village/ household cluster has been developed and tested by Indian Institute of Science, Bangalore in (i) Vizhinjam as a near-coastal village cluster near Trivandrum, and (ii) Ungra as a semi-arid village cluster near Bangalore. The elements undertaken under this project are: Comprehensive community study/ assessment including needs assessment/ evaluation, Interaction with officials to identify work strategy and community approach – Panchayat, local NGOs, health officials and doctors, Kudumbasree (family volunteers), TSC/ ICDS, NSS and Religious bodies (Church & Jammat), Extensive documentation of community hygiene practices and status of living, environment, evaluation and adoption of the 'Sanitation Approach', Understanding systemic causal relationships between sanitation and hygiene practices, instances of diseases, livelihood, income and family welfare, Comparative analysis to identify state of sanitation within a community, Identification of appropriate gender specific intervention/ approach in the provision of improved sanitation facilities.

Major Programmes Implemented

Rural Women's Technology Park

To consolidate the efforts initiated in earlier phases of the scheme, the concept of setting up of Women Technology Parks (WTP) was actualized. These rural WTPs act as windows for providing information, creating awareness, giving training for appropriate technologies leading to skill up-gradation and also establish the important forward and backward linkages for income generation through micro enterprises for women. Since geographic and agro-climatic aspects are one of the major distinguishing features demanding location specific orientation, these Technology Parks are set up for special terrains such as coastal, hill and arid zone. WTPs have been facilitated in Andhra Pradesh, Arunachal Pradesh, Assam, Gujarat, Karnataka, Kerala, Madhya Pradesh, Maharahtra, Orissa, Pondicherry, Rajasthan, Tamil Nadu, Uttaranchal, and West Bengal. Technology areas, which are addressed in these WTPs, are post harvest processing, soil fertility management, medicinal plant cultivation & semi processing, nursery techniques, aquaculture and energy besides focusing on drudgery reduction devises and women's health.

Developing community based approach for prevention and management of anaemia through nutritional inputs and awareness among young rural women in India

Anaemia remains a major health problem in rural India with more than half of the pregnant women in rural India suffering from iron deficiency anemia. Iron supplementation is being implemented in India for last two decades. However; compliance in rural areas is far from satisfactory. Creating nutritional awareness to promote consumption of iron rich foods like Green Leafy Vegetables (GLV) has been felt to be a more meaningful and long lasting solution. A programme involving interventions of iron rich locally available foods through promotion of nutritional knowledge and awareness among young rural mothers was launched

in the form of a Coordinated Programme on Green Leafy Vegetables (AICP – GLV) involving State Universities and Voluntary Organizations at 16 sites in 10 States. The mainstay of this programme is sustained awareness generation and continuous monitoring for optimal impact.

Large scale employment generation in coastal India through sustainable utilization of marine bio-resources

Large scale employment generation in Coastal India through sustainable utilization of Marine Bio-resources is being implemented by Universities and Voluntary Organizations through a coordinated programme for establishment of cultivation farms by local SHG's of fisherwomen population to develop a demonstration farm, harvesting and drying technologies, training and dissemination of the technology for their livelihood generation & economic sustainability along various coastal states of India. This programme has been implemented in coastal regions of Gujarat, Maharashtra, Kerala, Tamil Nadu, Orissa and West Bengal. Over 1000 fisherwomen have benefited from the programme.

National Award for Women's Development through Application of Science & Technology

SEED Division is implementing an award scheme titled "National Award for Women's Development through Application of Science & Technology" under the programme S&T for Women since 2000. This award is being given every year and carries a cash prize of Rs. One lakh for individuals and Rs. Ten lakhs for institution along with a citation. This award for the year 2008 was given away by Shri Prithviraj Chavan, Honorable Minister of State (IC) Science and Technology on 26 February 2010. The recipients of this year's award were Dr. V. Geethalakshmi, Professor, Agro Climate Research Centre, Tamil Nadu Agricultural University, Coimbatore; Dr. (Smt.) Rama K. Naik , Director of Instruction (HSc), College of Rural Home Science, University of Agricultural Sciences, Dharwad under the category of individuals and Himalayan Environment Studies and Conservation Organization (HESCO), Village Shuklapur, PO Ambiwala, Dehradun.for their outstanding contribution in the field of economic and social empowerment of women in rural areas through structured radio lessons on health foods nutrition, sanitation, reproductive rights, non communicable diseases and reduction of drudgery for women, to the development of a weather based agro advisory service for the benefit of the farming community creatively using a communication network of electronic and mass media and towards women empowerment in the Himalayan region through gender specific S & T interventions, respectively.

Fellowship Scheme for Women Scientists

WOS-A

The 'Women Scientist Scheme-A (WOS-A)' of DST is aimed at providing opportunities to women scientists and technologists for pursuing research in frontier areas of Science and Engineering. A special provision has been made under this scheme to encourage those women scientists who have had break in their careers. It provides a launch pad for them to return to mainstream of Science and work as bench-level scientists.

Since its inception in 2003, the Department has supported 853 projects in different disciplinesThe age-wise distribution of women scientists supported under the Scheme shows that maximum number (approx. 70%) of selected candidates are in the age-group of 35-50 years, which seems to justify its aim. This year 174 projects have been sanctioned this year. During the year, the Department has also monitored 162 ongoing projects funded under this Scheme.

The Department started Sensitization Workshops on Women Scientist Scheme – A (WOS-A) in 2007 to popularize it among scientists and technologists in various parts of the country and also to mentor them. Department has organized Sensitization Workshops at Hyderabad, Gorakhpur, Srinagar, Imphal, Visakhapatnam, and Port Blair.

Analysis of overall performance indicates that these women scientists have contributed more than 450 research papers and 30% of the awardees have got employment in universities and national labs– a significant addition to the scientific workforce of the country.

Department has initiated a special programme "CURIE" (Consolidation of University Research for Innovation and Excellence in Women Universities) in 2009 specifically for the women universities to enhance their R&D infrastructure. During the year Four (4) Women Universities have been supported for 3 years on the basis of their overall performance. These are: Avinashilingam Women University, Coimbatore Banasthali University, SNDT Women University, Mumbai Sri Padmavati Mahila Visvavidyalayam, Tirupati.. This new initiative is expected to make an impact on the quality of research output from these universities.

Fellowship Scheme for Women Scientists for Societal Programmes (WOS-B): The scheme for women scientists for societal programmes (WOS-B) is designed to fulfill various objectives in a challenging inter-disciplinary field for the development of the society. Over 150 women scientists have benefited from the scheme since its inception in 2003. During the year 2009, a number of projects on societal importance were sanctioned to the women scientists, who, somehow, could not continue with mainstream science work. The programme attracted these women to re-enter and take up R&D with S&T institutions. These projects were in the areas of agriculture, horticulture, health, environment, pharmaceutical, natural resources regeneration, etc.

In one of the projects being implemented in Amda village of Kotra Tehsil of Udaipur District, revealed that 100% of the households have been using fuel-wood collected from nearby forest. The average cooking time for tea, Rabari and other meals was 23, 68 and 78 minutes respectively through traditional Chulla, whereas with improved Chulla a net saving of 3, 19 and 31 minutes for the respective items was achieved. Thermal efficiency was also evaluated with traditional cook stoves and double pot improved cook stoves, which was found to 9 and 27 percentage respectively. It was also found that 75% of female, 60% male were in poor health conditions. Experiments have been conducted which result in fuel-wood saving, reduced cooking time, less smoke, less drudgery through better design and user friendly Chulla, which can also be maintained easily.

Fellowship Scheme for Creating Self-Employment Opportunities in IPR (WOS-C)

The WOS-C scheme of DST is being coordinated and implemented by the Patent Facilitating Centre (PFC) of TIFAC since its inception in the year 2002. Under this scheme the selected women scientists are trained for one year in the area of IPR, mainly patents. The training is being carried out at four different centres at New Delhi, Chennai, Kharagpur and Pune. 150 women scientists have been trained and 74 candidates have successfully cleared the Patent Agent Examination conducted by the Patent Office of India. As a cash incentive for clearing this exam, the women scientists have individually been provided Rs.10,000/- each. Most of these women scientists are now well placed and are pursuing their career in the area of IPR.

The training for the 71 candidates of the fourth batch was completed in April 2009 and training for the fifth batch started on 11 May2009. 83 candidates are attending this training. The sixth batch is expected

to start the training in May 2010. A written examination of the shortlisted candidates was held on 31 January 2010 and 1021 candidates appeared for the examination and 257 candidates have now been called for the interview.

Task Force for Women in Science

In December 2005, the Government of India set up a Task Force on Women in Science. DST was given responsibility to provide the necessary support. The Task Force had members representing different disciplines of science, institutions and different regions of the country. The mandate of the Task Force was to recommend appropriate measures to promote and encourage women to take up S&T professions; to formulate a time bound plan of action for these measures; to suggest measures to motivate girls to take up S&T for higher education and develop a scientific temper and awareness; to interact with other scientific departments/ organizations on implementation of gender enabling measures; and to consider and recommend other proactive measures to bring about a greater involvement of women in S&T.

The Task Force held meetings in different geographical parts of the country. All the meetings included interactions with women scientists, so as to gather information, suggestions and feedback from them. It facilitated the setting up of a website, www.indianwomenscientists.in This website now hosts a Directory of Indian Women Scientists, which is a useful database that can be consulted when choosing speakers for conferences, members of selection committees, etc. It also provides an interactive forum for women scientists to network and share information.

A book of compilation of achievements of prominent women scientists is being brought out. Such books would serve to inspire young girls to take up science as a career.

A portrayal of gender in school science textbooks was an issue which was addressed by examination of school text books for adverse portrayals. This was done by the Homi Bhabha Centre for Science Education and Research, Mumbai. An adverse portrayal in such textbooks can reinforce prejudices, while a positive portrayal could encourage more girls to study science.

Study and Practice of Science by Indian Women – The Current Status:

- Though the percentage of girls studying science in Indian universities has increased since Independence, the ideal fraction of 50% of female students has not been achieved; in fact there is evidence that the percentage has plateaued at a lower level.
- The percentage of girls studying engineering is even lower than in basic science. The situation in the IITs is particularly dismal.
- Some parts of the country appear to be lagging behind. Gross regional disparities are evident, greater effort is needed here to increase the percentage of girls studying science.
- There is a drastic drop in the percentage of women, from the doctoral level to the scientist/ faculty position suggesting a bottleneck at the employment stage, due to recruitment procedures and family responsibilities. Focused efforts are needed to identify the sources of this precipitous drop, and counteract them.
- Another striking observation is the paucity of women at the senior most administrative and policy making positions in the scientific institutions.

The report of the Task force for women in science evaluates the present situation for women scientists in India, attempts to identify the societal and institutional reasons as to why women scientists appear to be at a disadvantage, and suggests some measures that could be taken to improve the situation. The Report of the Task Force for Women in Science was released by the Hon'ble Minister of State (IC) for Science & Technology and Earth Sciences at a function held on 27 January 2010 at Vigyan Bhavan, New Delhi.

A Standing Committee has been set up under the Chairmanship of the Hon'ble Minister of State (IC) for Science & Technology and Earth Sciences to formulate guidelines for creating a gender enabling environment in S&T institutions and organizations, recommend special measures to ensure growth of women scientists in their professional career keeping in view leadership role they may have to play, consider setting up special cells for women in science in the State S&T Councils and Departments and in S&T institutions and organizations, recommend and approve programmes designed specifically for fostering utilizing and supporting women in S&T, ensure that organization/ institutions adhere to the principles of gender justice, monitor periodically implementation of various recommendations of the Government for facilitating appointment, working and promotion of women scientists in S&T organizations and also general recommendations in respect of working women, ensure that complaints of women scientists related to their workplace are attended to quickly by their respective organizations, keep the Government informed about it's activities. A Technical Advisory Committee has also been set up to advise the Standing Committee.

FLY ASH UNIT

The focus of Fly Ash Utilization (FAU), DST during the year 2009-10 was primarily on the following :-

- To support & facilitate exploration and development of new technologies/ applications of fly ash as well as incremental S&T developments in the existing technologies.
- To facilitate adaptation/ large scale application of technologies for large scale utilization/safe management of fly ash, including scale ups & setting up of demonstration projects, as well as establishing technology transfer/ facilitation mechanisms including compilation & dissemination of information & technologies.
- To prepare & update standards/specifications etc. for sustainable utilization/ safe management of fly ash.
- To provide S&T support & facilitation to other Government Ministries/ Departments/ agencies and to work along with them towards large scale sustainable use/ safe management of fly ash.

The Ongoing projects approved during earlier years totaling to 30 nos. have been facilitated for implementation including holding of progress review meetings.

7 workshops/seminars on fly ash utilization/safe management have been facilitated/ participated.

Impact Made

The fly ash that was considered as an environment pollutant before start of "Fly Ash Mission" has now been accepted as a valuable raw material for many industries. This is by virtue of development of appropriate technologies for use of fly ash, their demonstration and confidence building that is initiated and facilitated by DST. The fly ash has now become a tradable commodity. Ministry of Environment & Forests notification of 3/11/2009 has permitted marketing of fly ash that was earlier required to be given free of cost (as a statutory requirement) to facilitate of its potential users to use it and develop understanding

of it's gainful effects. Current utilization of about 80 Million Tonne fly ash per year out of annual generation of 160 Million Tonne results in economic wealth generation of about Rs.20,000 crore per year, employment of more than 40,000 person, conservation of mineral resources and reduction in CO2 generation by 300 lakh tonne per year.

The Hon'ble Railway Minister has also identified fly ash has a new traffic stream during her Railway Budget (year 2009-10) speech. The Indian railways has increasing demand for fly ash wagons.

Siberian Fedral District, Russian Federation took a note of developments in fly ash area in India and especially the impact made by the "Fly Ash Mission". The Omsk region, delegation on fly ash lead by Honorable Mr. Gorbunov Alexendr Vladimirovich, Minister of Industrial policy, transport and Communications of Omsk region, Siberian Federal District, Russian Federation with other representatives from Siberian Energy Association and JSC TGK #11 visited India during 7-16 September 2009. Siberian Federal Region has expressed their need and desire for co-operation by Indian side to put in place the mechanism like "Fly Ash Mission–India" to facilitate development and application of technologies for utilization and safe management of fly ash in Omsk Region as well as in other regions of Siberia in association with Siberian Energetic Association, including import of technologies from India.

During the year following 8 new projects were commissioned:

- "Sysnthesis characterization and applications of several catalytic materials based on coal generated fly ash", submitted by University of Kota
- "Exploiting fly ash in minimizing herbicide transport in agricultural soils", submitted by IARI, New Delhi
- "Investigation on Ash disposal system of a thermal power plant for transporting Bottom ash slurry at higher concentrations", submitted by IIT, Roorkee
- "Assessment of reclaimed ash ponds and fly ash treated agricultural fields with special emphasis on alteration of metal availability in soil, growth pattern of establishment plants, fate of toxic metals therein and subsequent changes in microbial diversity" submitted by The Energy and Resources Institute, New Delhi
- "Use of fly ash in raising forestry nursery and forest plantation" submitted by Institute of Minerals & Materials Technology, Bhubaneswar
- "Studies on the influence of fly ash seed pelting on growth and yield parameters in sesame" submitted by Anmnamalai University, Annamalainagar.
- "Confidence building and facilitation of large scale use of fly ash as an ameliorant and nutrient source for enhancing rice productivity and soil health", submitted by Central Rice Research Institute, Cuttack
- "Technology Development for geopolymer pavement tiles from fly ash", submitted by National Metallurgical Laboratory, Jamshedpur.

CHAPTER 5

S&T BASED SERVICES, SCIENTIFIC INSTITUTIONS AND PROFESSIONAL ACADEMIES

SURVEY OF INDIA

The saga of mapping of the Indian landmass, inch by inch, over grains of sand, to crystals of ice is unparalleled in Indian history – it continues to the present day providing the vital inputs in nation building. Advancements in ICT technologies have made possible the capture, processing, storage and transformation of spatial data, swift and error free. In the areas of production of customized map products and their dissemination, computers have made a world of difference. Having a very strong human resource base in the IT sector and with the SOI maintaining the National Topographic Database in the digital mode, India stands poised to usher in a flourishing geospatial industry. The Survey of India (SOI), the National Surveying and Mapping Agency, is a subordinate Department of DST stands committed to nurturing this new industry in all possible ways.

SCIENTIFIC RESEARCH

Antarctica Expedition

Survey of India is contributing significantly towards establishing permanent stations at Antarctica in pursuit of collecting scientific information and observations needed for growth of the region. The main objectives of Survey of India in Antarctica are as flows

- Large scale mapping of the Schirmacher Oasis on scale 1:5,000 with contour interval of 5 meters
- Establishment of relative gravity network of 1 km. mesh at Schirmacher Oasis, connecting all GPS stations.

NEW STATION SITE LARSEMANN HILLS (ANTARCTICA)

- Preparation of different gravity anomaly maps of the Schirmacher Oasis region on 1:5,000 scale with contour interval of 1mgal.
- To monitor the plate movement of the continent with respect to Indian plate.
- Studies for neo-tectonic activities of the Antarctica region.
- Large scale mapping of Larsemann Hills on scale 1:5,000 with contour interval of 5 meters

Achievements

During the 28th Indian Scientific Expedition to Antarctica 2008-09 at Larsemann hills, Large scale mapping on 1:5000 scale with contour interval 5 metre was carried out for an area of **2.41 sq. km.** and at Schirmacher Oasis, Large scale mapping on 1:5000 scale with contour interval 5 metre was carried out for an area of **1.44 sq. km.** Draft copy of station site Map (Final) on 1:1,000 Scale of Larseman Hills is submitted to NCAOR, Goa. Preliminary report of the 28th Indian Scientific Expedition has been prepared, computations are in progress and the map for the Larseman Hills area is being digitised.

Human Resources for Indian S&T Advancement

Indian Institute of Surveying & Mapping, the capacity building arm of SOI conducted various training programmes during the year. The training imparted to departmental officers of various levels and officers nominated by various Scientific/ professional organizations. 34 Basic/Scheduled courses including 5 Advance courses were conducted during the year and 530 trainees underwent such courses. 398 officers nominated by various Scientific/professional organizations and 27 Engineering students participated in 20 special courses. 24 foreign nationals sponsored by the Royal Government of Bhutan and 5 sponsored by Oman were among those attended the scheduled courses.

Technology Development Programmes

Dual Map Series

Survey of India generates two series of maps – Defence Series Maps (DSMs) meant for Defence and the Open Series Maps (OSMs) for public use.

Defence Series Maps (DSMs) - Topographical maps for the entire country on WGS-84 datum and polyconic projection on 1:50,000 Scale with heights, contours and full content by departmental staff only.

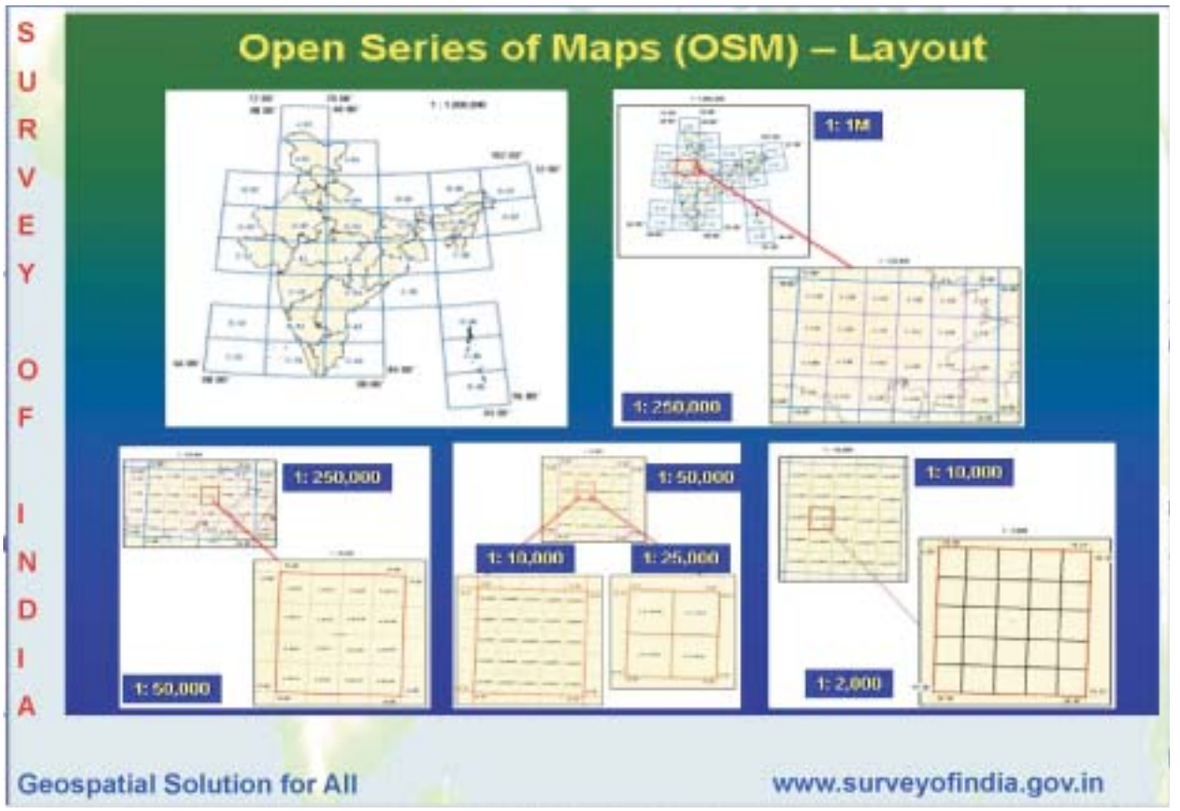
Open Series Maps (OSMs) - Topographical maps for the entire country on WGS-84 datum and UTM projection on 1:50,000 scale from updated digital data base and patterning of digital data for publishing maps by departmental staff and as well as through out- sourcing.

Achievements

1. 1:50,000 scale topographic data.

   a) Completed updation of digital data base pertaining to 4,267 sheets from field verified data. Field updation of map data has been completed for 4507 sheets.

   b) Transformation of 4200 sheets, Patterning of 2303 sheets and printing of 850 sheets from updated digital data base on 1:50,000 scale pertaining to OSM have been completed.



c) Transformation of 3150 sheets, Patterning of 1632 sheets and printing of 250 sheets from updated digital data base on 1:50,000 scale pertaining to DSM have been completed.

2. 1:25,000 scale topographic data.

Digital Data generation is under progress as mentioned below:

Total sheets on 1:25,000 scale	= 19,390
Sheets surveyed so far	= 12,207
Sheets published in hard copy form	= 7,874
Sheets digitised so far (in soft copy form)	= 5400

Tidal Data

Survey of India maintains a series of tidal observatories located all along Indian Coast and Islands. Tidal data generated through tide gauges installed in tidal observatories is quality controlled and then used for upgradation of Harmonic constituents. These in turn are used for tidal predictions and are brought out in the form of Indian Tide Table.

Achievements

Tidal observations are carried out on regular basis for tidal predictions. Survey of India has contributed in establishing Tsunami Early Warning System. Under the project, "Modernisation of Indian Tide Gauge

Network" 25 tidal observatories located along Indian Coast and islands have been upgraded by installing digital tide gauges co-located with GPS receivers. Data is received at National Tidal Data Centre / National GPS Data Centre in Real time through dedicated VSAT network.

Redefinition of Indian Vertical Datum

A project of National importance on Redefinition of Indian Vertical Datum is being implemented that is completely based on scientific principles at par with the international standards i.e. Geo-potential numbers and caters to the needs of planners as well as development projects of the country. The project was planned and carried out keeping in mind the following main objectives: provide dense network of precise Benchmarks which will have their Geo-potential number, Orthometric heights and gravity values. Establishing connection of these BMs to all the Tide Gauge Bench Mark so that sea level variation studies can be carried out. These BMs will be used in further densification all over the country and to provide height to the Ground Control Points (GCPs).

SCHEME OF THE PROJECT

Achievements

Phase-I

High precision leveling (Fore and Back direction) about 45775 lin. km. and gravity observation along H.P. leveling line on 3282 station has been completed. Preparation of data set for High precision leveling network adjustment has been completed. Network adjustment of the junction point BMs of mainframe has also been completed. Scrutiny of description of BMs and adjustment of individual BM is under progress.

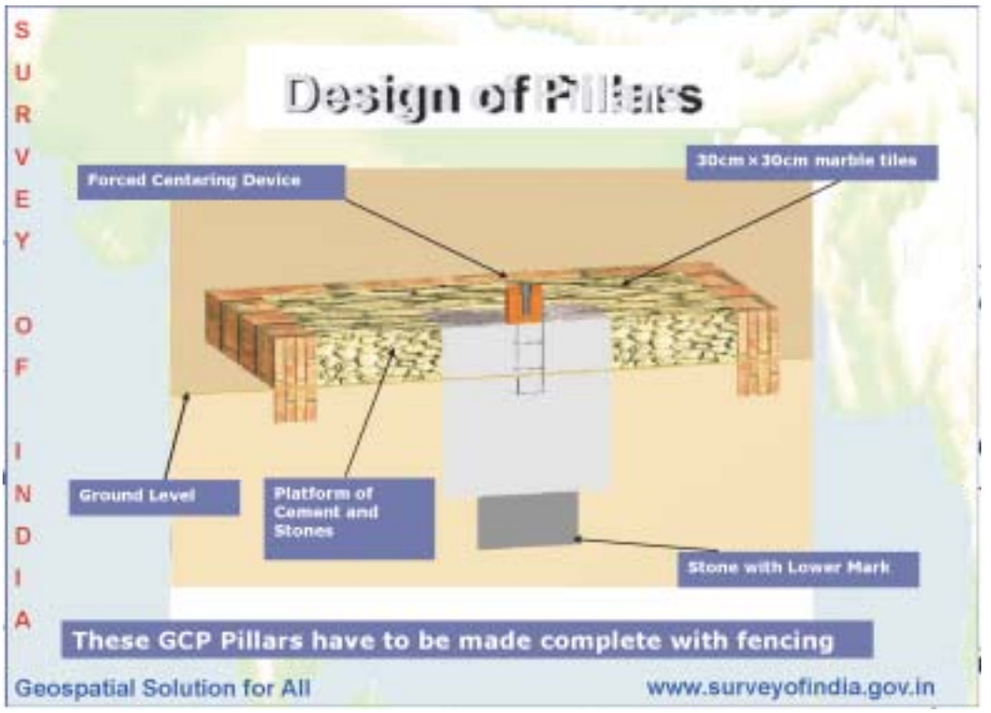
Phase –II

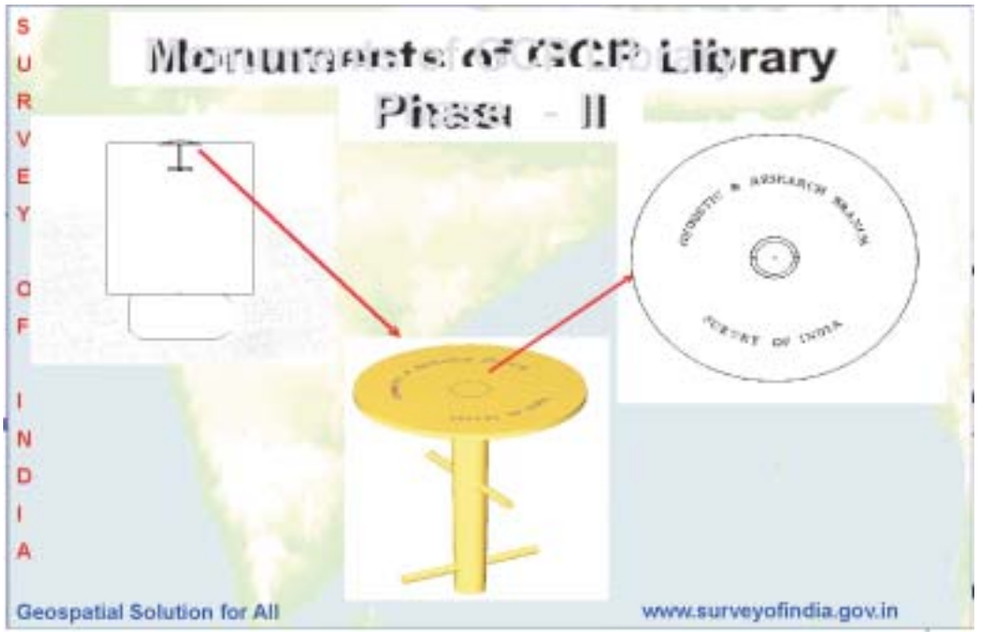
HP Levelling work for densification is under progress. HP leveling in Fore direction -2668 lin. km. and 1751 lin. km. in Back direction has been completed so far.

National Standardised Control Framework

Survey of India has taken up the task of establishing a network of well spread standard ground control points throughout the country to enable state cadastral department besides other agencies engaged

in generating geo-spatial information to carry out their job in a national geodetic reference system. This task will be carried out in three phases. The first phase envisages the establishment of 300 high precision Ground Control Points (GCPs) at a spacing of 250-300 km apart. In the second phase, the responsibility will be to densify it with 2200 precision Ground Control Points at a spacing of 30 to 40 km apart and in the last phase, it will be further densified to 65,000 GCPs.





Achievement

300 Ground Control Points (GCPs) covering the entire country have already been completed in 1st phase. Densification of first order network at a spacing of 30 to 40 km. apart is under progress. Reece/ Site selection of 1774 points, construction of 1533 pillars and GPS observation at 418 stations have been completed so far.

International Science And Technology Cooperation

Survey of India is running the courses for Permanent Committee on GIS & Infrastructure for Asia Pacific (PCGIAP) Region in GIS for establishment of Spatial Data Infrastructure (SDI) at Indian Institute of Surveying & Mapping . Survey teams from Geodetic & Research Branch of Survey of India are sent to Bhutan for imparting Gravity & Geo Magnetic Survey on the job training to Bhutanese survey officers under Govt. of India, Ministry of External Affairs approved Project "Technology Transfer and In-house Capacity Building in Gravity and Magnetic Survey Work" for the Royal Govt. of Bhutan.

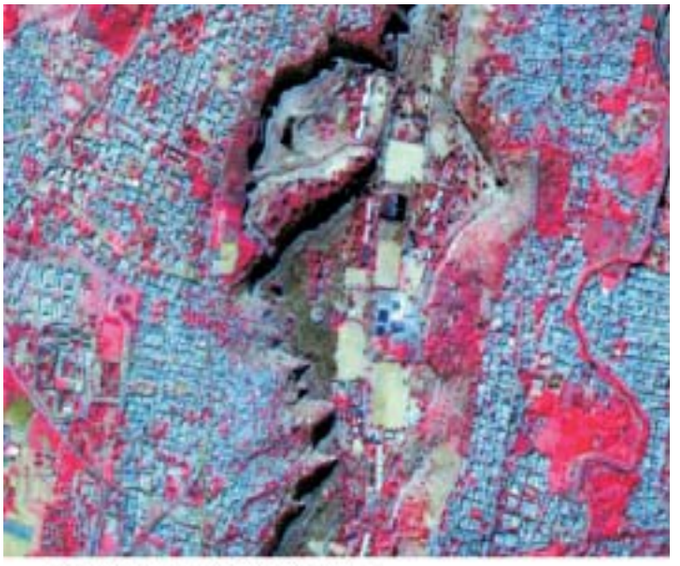
National Science and Technology Management Information Systems

Urban Mapping for NUIS

The objective of the project is to develop attribute as well as spatial data base for various levels of urban planning and decision support to meet requirements of urban planning and management. Survey of India in collaboration with Ministry of Urban Development has taken up the work to generate and supply the geo-spatial data required for the project.

Databases to be developed at two levels on 1:10,000 scale GIS database for Development/ Master Plan for 152 selected towns using remote sensing satellite imagery and on 1:2,000 scale GIS database for detailed town planning schemes using high resolution remotely sensed data sources (Aerial Photographs) for the same 152 selected towns. On 1,000 scale Utility Maps derived from the 1:2,000 base maps, for 22 towns to be undertaken using Ground Profiling/Penetrating Radar (GPR) technology.

Geo-referenced Satellite Imagery of Gwalior City for Thematic Mapping
MERGE PRODUCT (2.5 RESOLUTION) OF P5 (2.5 RESOLUTION) & P6 (5.8 RESOLUTION)



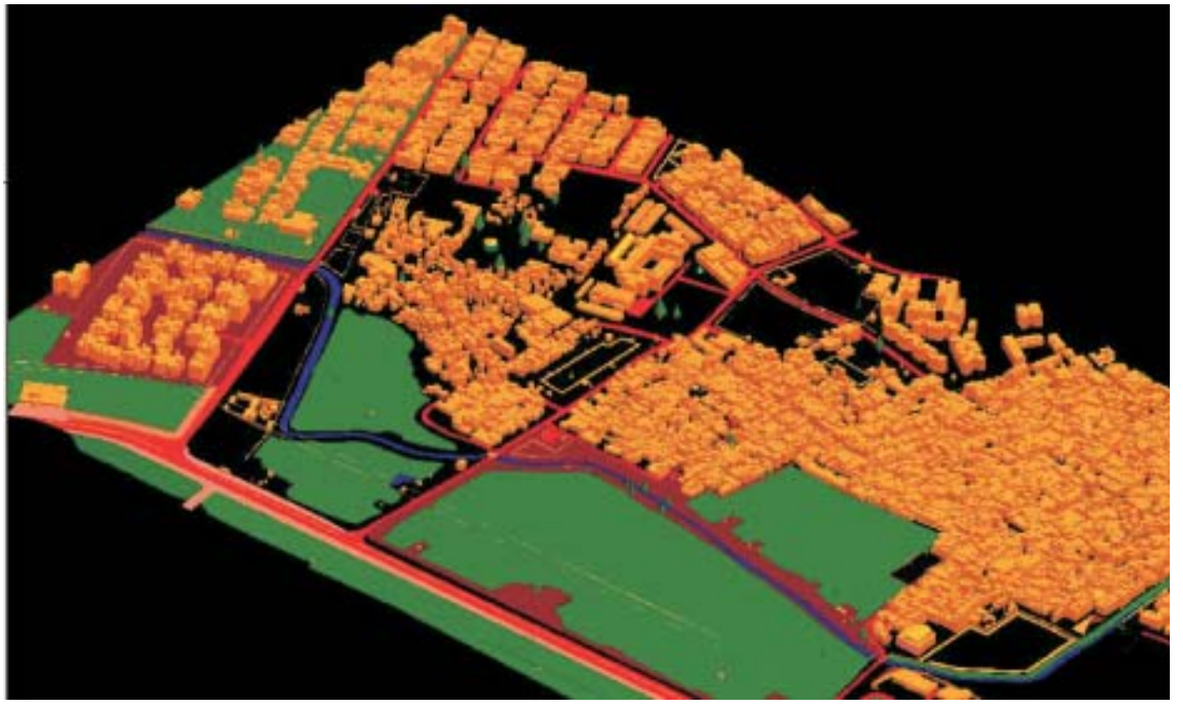
Achievement

- Databases on 1:10,000 scale - Satellite Imagery collected and Geo-referenced for all 152 towns, Thematic Mapping completed for 55 towns and mapping under progress for rest of the towns.
- Databases on 1:2,000 scale -Aerial Photography completed for 87 towns, Mapping completed for 9 towns and under progress for rest of the towns
- Databases on 1:1,000 scale (GPR Survey) -Firm has been identified for assignment of the job.

Projects of NIC

Information and accurate data is an essential pre-requisite for framing the policy. One of the important ingredients of proper planning is the availability of data so that it may act as a catalyst in the decision making process. In this background, Planning Commission has conceptualized various projects through National Informatics Centre (NIC) and Survey of India has to generate and supply the required data through NIC.

a) Geo-referencing & Feature Extraction from IRS PAN Imagery
b) Supply of Georeferenced High Resolution Satellite Imagery of 580 Towns
c) Supply of Village Boundary Data
d) GPS/ETS Survey of Kavaratti for Cadastral mapping
e) Computer Aided Digital Mapping (3D–GIS) of Mumbai, Chennai and Ahmadabad
f) Supply of 50K Data



Sample Digital Base Map (3D–GIS)

Achievement

Georeferencing & Feature Extraction From Pan Imagery: The IRS PAN imagery as and when received from NIC was geo-referenced along with limited feature extraction data on 1:50,000 scale and supplied to NIC.

Supply Of Georeferenced High Resolution Satellite Imagery Of 580 Towns: Geo-referenced high resolution satellite Imagery data pertaining to 559 towns has been supplied to NIC and confirmation for fresh imagery awaited from NIC in respect of 21 towns.

Supply of Village Boundary Data:The village boundary of each village was surveyed in the field and converted in digital form. Attributes are attached to each village and compiled district wise. Data pertaining to almost all districts has been supplied to NIC.

GPS/ETS Survey of Kavaratti for Cadastral mapping: Job completed and data supplied to NIC.

Computer Aided Digital Mapping (3D–GIS) of Mumbai, Chennai and Ahmadabad: - Feature extraction along with attribute data collection, 3D data validation and field attribute attachment to geo-coded data has been completed and data supplied to NIC.

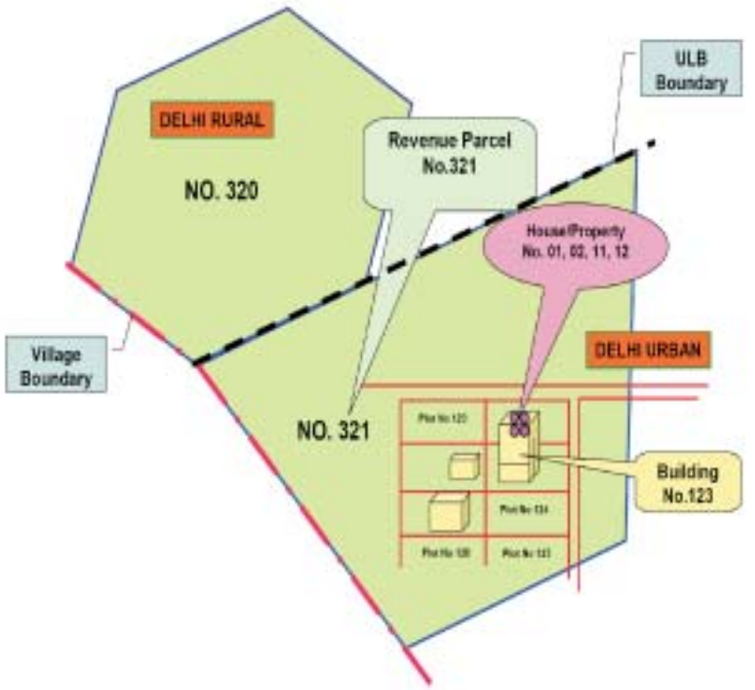
Supply of 50K Data: Supplied digital data on 1:50,000 scale pertaining to 4670 sheets to NIC**.**

Delhi State Spatial Data Infrastructure (DSSDI) Project

Survey of India has signed an MOU with Govt. of National Capital Territory of Delhi to create Land Information System and central data base for all Govt. Department of GNCTD and 3D GIS solution including generation of large scale base map which has the following work scheduled:

- Extension of framework control, Aerial Triangulation, DEM generation and preparation of Ortho-photo.
- System design, data modeling, system integration and operations.
- Primary data capture and creation of comprehensive LIS and UIS.
- Generation of 3D Pictorial GIS for entire NCTD.

PROPERTY GIS CONCEPT



Achievement

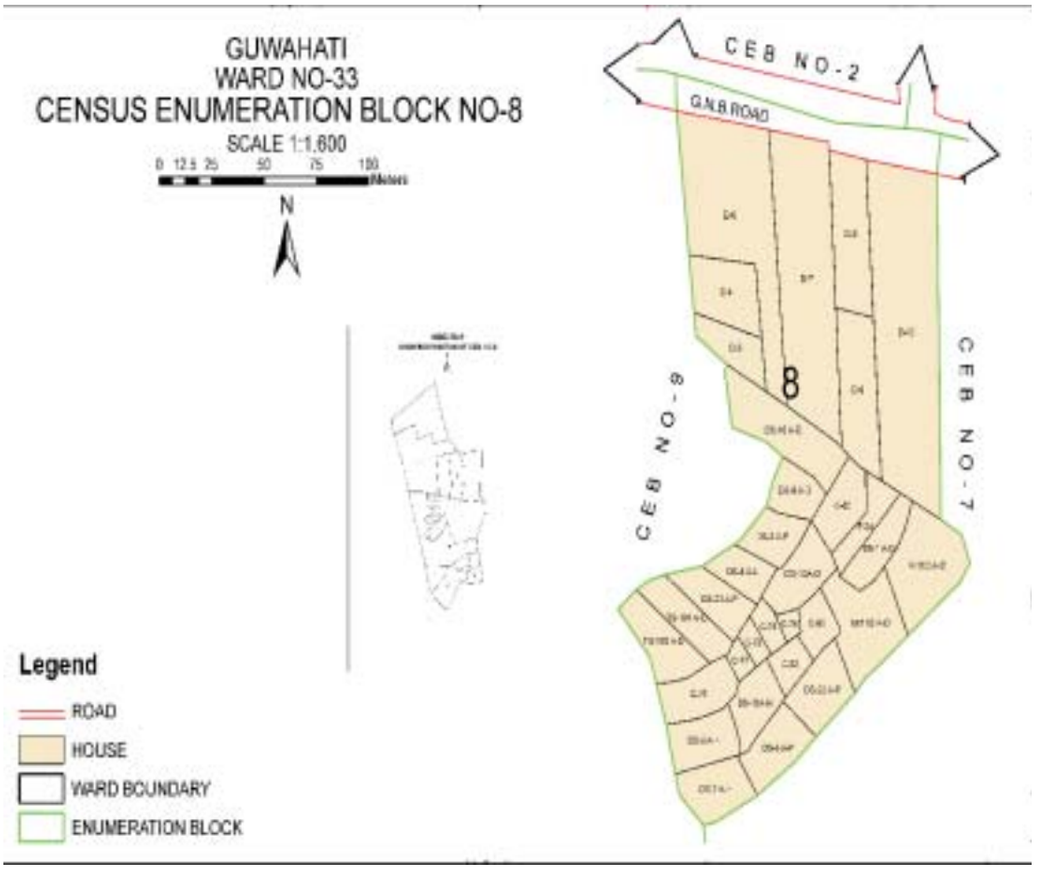
Extension of framework control, Aerial Triangulation, DEM generation and preparation of Ortho photo has been completed. Installation, Testing, Integration and operationalisation of 2 main control centres, 1 monitoring centre is completed and work is in progress for installation of equipments at remaining 9 centres. Delhi Geo Portal for DSSDI project is completed.

3D Feature extraction, Ground validation over ground utility survey & creation of topographical database has been completed. Property survey for property GIS, linking of property data with the buildings and Utility Mapping (Underground) is likely to be completed soon. 3D Topology generation completed for all 9 districts (1424 sq.km.) accept restricted area.

GIS Based Mapping of Cities/Towns

Registrar General of India (RGI) has taken up a project with Survey of India to prepare GIS based digital map of each capital city as preparatory to 2011 Census. Survey of India has to supply printouts of satellite imageries in 1:4,000 scale or higher scale for capital cities. RGI draws the ward boundaries on the satellite imageries and collect information from the field with the help of local municipalities in the prescribed format. SOI prepared the ward maps in digital format containing the ID of the house in PAT file (as key field) and after linking the attribute data hand over the soft copy and hard copy to ORGI for demarcating CEBs for use in 2010 Census.

SAMPLE WARD MAP OF GUWAHATI CITY



Achievement

Survey of India has supplied high resolution satellite imageries of 22 capital cities to RGI for drawing ward boundaries and collection of requisite information from field. Survey of India has also completed digitisation of 650 wards so far.

Science and Technology Programmes for Socio – Economic Development

Topographical activities:

(a) Control Work:

• Traverse	864 linear km
• Levelling	1,023 linear km

(b) Surveys:

• Boundary demarcation (Indo-Pak)	86 linear km
• Boundary demarcation (Indo-Bangladesh)	4820 linear km
• Joint demarcation /relocation of missing / Damaged boundary pillars (India – Bhutan)	109 pillars
• Verification surveys for IAF	10 Airports

(c) Fair Mapping:

• Topographical (post field updation)	250 sheets
• Digital Mapping (DCDB for OSM) on 1:50,000 scale	1082 sheets
• Digital Mapping (DCDB for DSM) on 1:50,000 scale	1632 sheets

(d) Printing:

• Printing of various types of maps	1075 Maps

Digitisation and creation of Digital Cartographic databases

• Departmental maps on various scales	400 Maps on 1:25,000 scale
• Extra Departmental maps on various scales	100 Project maps

Geodetic and Geophysical surveys:

a) Geodetic surveys for monitoring of progress of various developmental projects are in progress.

b) During the year, carried out the following tasks:

• GPS observations	450 stations
• Precision Levelling	1751 linear km
• EDM Traverse	50 linear km
• Gravity observations	3282 stations
• Installation of Tide Gauges	25 stations

Science and Technology Based Services

The following projects based on latest available technologies have been taken up.

Hydro- Electric Projects:

Large scale survey with provision of precise height and planimetric controls for planning of various Hydro-Electric Projects at different places have been taken up.

Uhl H. E. Project (Himachal Pradesh): Checking of Tunnel Alignment and Supply of Control data (Coordinates and BMs Hts.). Work completed in all respect and data has been supplied.

Renuka Dam Project (Himachal Pradesh): Supply of control data (Coordinates, BMs &Hts,) & mapping on 1:500 and 1:2,500 scale. Work completed in all respect and data has been supplied.

Sone River Flood Management & Integrated Land Development Survey (Himachal Pradesh): Supply of Control data (Coordinates, BMs &Hts,) & mapping on 1:10,00 scale. Work completed in all respect and data has been supplied.

Rampur HE Project (Himachal Pradesh): Checking of Tunnel Alignment and Supply of Control data(Coordinates and BMs Hts.). Work completed in all respect and data has been supplied.

Sainj HE Project (Himachal Pradesh): Supply of control data (Coordinates, BMs &Hts.). Work completed in all respect and data has been supplied.

Loharinag-Pala H.E. Project (Uttrakhand): Supply of control data (coordinates and BMs &Hts.). Work completed in all respect and data has been supplied.

Tawang Basin Project (Arunachal Pradesh): Provision of Ground Control & Detail Survey on 1:5,000 scale with contour interval 5 meters in 16.5 sq. km. area for NHPC Ltd. Field work and digitization completed in all respect. Data sent to GSGS for security clearance.

Punatsangchhu HE Project (Bhutan) : Work completed in all respect.

Nirmala Nagara Project & Karnataka Municipal Reforms Project

Digitisation and Integration of wards maps of Nirmala Nagara Project: Wards integration matched for 1243 wards and 1600 wards has been digitized.

Preparation & digitization of block maps of KMR Project: Base map prepared for 1076 Sheets and 993 Blocks has been digitized.

NATIONAL ATLAS & THEMATIC MAPPING ORGANISATION

National Atlas and Thematic Mapping Organization (NATMO) is a subordinate office under the administrative control of DST. The organization has a total strength of 400 which includes a large number of qualified professional geographers and Cartographers. It is a premier organization in the field of preparation of thematic maps.

The main objective of organization is to help the planners to use maps as development tools for resource mobilization at grassroots level. State Atlases help in a big way for better planning when resource database is available in Atlas form. Historical & cultural heritage atlases are the comprehensive cartographic record of historical and cultural heritage of India. Atlases for even visually impaired are being prepared to assist the blind persons to appreciate physical, cultural and socio economic aspects. Electronic Atlas of India will facilitate its users in different aspects of India as depicted in National Atlas in digital format. Golden Map Service covering whole of India is being prepared to provide village level information for any sorts of planning and developmental works. Target and Achievement for the Year 2009 -10 are given in the Table below:

TARGET AND ACHIEVEMENT FOR THE YEAR 2009 -10

	PROGRAMME	Target 2009-10 By no. of maps	Achievements 2009-10 By no. of maps
a.	DPMS (Revision)	6 maps	6 maps
b.	State Atlas of Bihar	4 maps	4 maps
c.	State Atlas of M.P.	5 maps	5 maps
d.	Special map	4 maps	4 maps
e.	School Atlas for visually impaired (English) to be continued as per TIFAC (DST) Programmed on regular basis.	6 maps	6 maps
f.	School Atlas for visually impaired in Assamese (to be continued on regular basis	5 maps	5 maps
g.	Electronic Atlas of India	10 maps	10 maps
h.	Golden map Service	10 Scenes	10 scenes
i.	Punjab State Atlas	5 maps	5 maps
j.	Re-printing of National Atlas Maps	6 maps	6 maps

Key Achievements

In July 2009, a team from Geo-informatics and Space Technology Development Agency (GISTDA), Ministry of Science and Technology, Government of Thailand visited NATMO to explore the possibility of training of their scientists in atlas, thematic and web cartography.

NATMO has organized a conference of Indian National Cartographic Association (INCA) in the month of November 2009. The prominent geographers and cartographers from different parts of the country have participated the conference and presented academic papers.

NATMO has been given the responsibility by NDMA to prepare DPR for 1:10,000 & 1:2,000 scale mapping.

Research, Development and Training

Regular activities on research and development is a continuing job and NATMO has done its share for the period successfully. In house training in thematic cartography, photogramatary, remote sensing and GIS has been taken up as and when necessary.

Other activities

Several NATMO officials actively participated in many national and international conferences and seminars.

NATMO Participated in regional, national and international exhibitions, book fairs to popularize the utility of the maps, atlases and database of NATMO.

Database creation through GIS is in progress as an ongoing job.

NATMO maps in electronic media are an ongoing project and are also done during this period.

Scanning, plotting as a part of extra departmental activity is also done for generating revenues.

As envisaged in the TIFAC, DST activity maps and Atlases for visually Impaired in regional languages have been initiated during this period in Bengali.

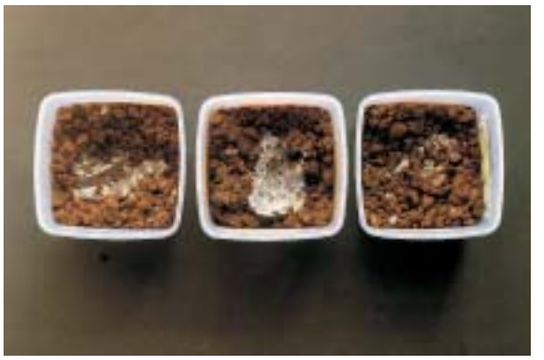
AGHARKAR RESEARCH INSTITUTE

Agharkar Research Institute of the Maharashtra Association for the Cultivation of Science is engaged in research in Life Sciences focusing on Microbial Sciences, Plant Sciences, and Animal Sciences with the targets of developing microbial processes, nanobiomaterials, genetic crop improvement, prevention of anemia, biodiversity studies, natural product chemistry, developmental biology and palaeobiology and palaeoenvironment. The research achievements of the institute are given here

Microbial processes

Production of biodegradable plastics by *Halomonas* sp.

Moderately halophilic and alkali-tolerant strain of *Halomonas* sp. was used to produce polyhydroxyalkanoate (PHA). The polymer produced was found to be a biodegradable copolymer of PHB-co-PHV having molecular weight in the range of 106. A film could be drawn from the polymer by solution casting technique. A joint Indian patent, application no. 1438/DEL/2008 is filed with Department of Biotechnology.



Biodegradability testing of PHA film formed by *Halomonas* sp. by soil burial method in soil containing 25% moisture. Intact PHA film (Left), PHA film degraded after 1 month (Centre), PHA film degraded after 2 months (Right)

Nanobioscience

Award winning nanobiotechnology

ì Spore - a new biomimetic technology for very long term preservation of DNA in nanoporous microcapsules of sporopollenin (a polymer from pollen grains) was standardized and patented

Prabhakar Kulkarni, PhD student won India Innovation Pioneers Challenge 2009 for 'µSpore DNA preservation technology'

Crop improvement

New Wheat Varieties MACS 6222 and MACS 6273

MACS 6222: highest yielding, early maturing, high test weight, highly resistant to black and brown rusts, ranked first and was significantly superior to best check NIAW 917 (5.4%) followed by Raj 4037 (8.0%)

MACS 6273 has shown superior and stable yielding ability under timely sown irrigated conditions with 4% to 6.4% yield advantage over the best checks NIAW 917 and Raj 4037 respectively. Best in quality attributes *viz*., highest grain hardness index (82), sedimentation volume (46 ml), grain protein content (12.9%), wet gluten content (35%) and dry gluten content (11.8%) than all the checks and qualifying entries. It possesses higher levels of tolerance against leaf rust as its maximum score under artificial conditions never exceeded 20S in all the three years of testing.

Potential additional economic benefit to the farmers due to these varieties is to the tune of Rs.500 crores per annum

MACS 6222

MACS 6273

Mapping Quantitative Trait Loci (QTL) for yellow pigment content

The major QTL explaining upto 55.22% of the variation in the trait, QYp.macs-7AL, was located on the distal part of the long arm of chromosome 7A. Two markers linked to a major QTL on 7AL were identified and subsequently converted to SCAR markers namely Xscar807 and Xscar3362. These markers were also validated in diverse genetic backgrounds for their effective use in Marker Assisted Selection (MAS).

Mapping QTLs for gluten strength

Glu-B1 and *Glu-B2* loci were also associated with gluten strength in durum wheat

Locus QSv.macs-1B.1 flanked by marker interval Xgwm550 - Glu-B3 was identified at LOD e" 4.19 in all the five environments and explained 9.18% to 40.66% of phenotypic variance in SDSS volume, also associated with many mixographic parameters

Soybean oil quality improvements

Molecular characterization of mutants with altered fatty acid composition: a) Isolation of microsomal omega-6 desaturase genes i.e. FAD2-1, FAD2-2, b) Gene expression studies in mutants with respect to genes in fatty acid biosynthesis

Human Nutrition in Health & Disease

Intervention studies - Prevention of anemia

A sustainable approach for reducing anemia in rural mothers is to increase nutritional knowledge and awareness about iron rich foods through social actions

Micronutrients and antioxidants in health and disease

Oxidative stress is caused due to increased production of free radicals in our body. Fruits like bel-fruit, purple grapes and amla and vegetables like bitter gourd showed high antioxidant activity. Folic acid inhibited liver zinc metabolism in a dose-dependent manner as seen through cell-culture and animal experiments, indicating caution in its supplementation.

Biodiversity

Plant biodiversity and bioprospecting

A network project for digitized inventory of medicinal plants of Maharashtra was initiated involving 14 collaborators covering all districts. Germplasm of non-edible oil seeds collected from various States of India were maintained at ARI farm for cultivation studies. Quick authentication keys for 206 plant parts were completed for pharmaceutical purpose. Significant anti-fertility and topical anti-inflammatory activity of Lawsone was recorded in Swiss albino mice. Eco-floristic studies, germplasm studies and *ex-situ* conservation of *Safed musali* complex (*Chlorophytum* spp.) was completed. Pharmacognostic evaluation of potential species of this complex has been completed. Work on seed and seedling studies on high valued medicinal plants was initiated.

Fungal biodiversity

Lichen flora of Karnataka

151 species of lichens of Karnataka were identified

Monographic studies of the lichen family Graphidaceae

Species documented 63

Species described as new 23

New combinations proposed 5

Genera recorded for the first time from India 6

Archaeal diversity of Andaman islands

No	Source	Eztaxon identification (Type strains)	% Homology*
1	Baratang #	*Methanoculleus palmolei* DSM 4273	82.72%
2	Baratang #	*Methanosaeta harundinacea* 8Ac	81.53%
3	Baratang #	*Methanosarcina vacuolata* Z-761	81.50%
4	Kattan #	*Methanosarcina lacustris* ZS	82.14%
5	Kattan #	*Methanococcoides alaskense* AK-5	82.33%
6	Kattan #	*Archaeoglobus fulgidus* VC-16	80.30%
7	Kattan #	*Methanomethylovorans thermophila* L2FAW	80.88%
8	Kattan #	*Methanohalobium evestigatum* Z-7303	80.25%
9	Mangrove #	*Methanoculleus submarinus* OCM 780	83.04%
10	Radhanagari Beach Sand sample	*Haloferax alexandrinus*(Extremely Halophilic-Optimum 25% NaCl)	97 %

Mud volcano sample, *<97% homology with reference sequences in GenBank database indicates novel species Aerobic, extremely halophilic archaeon *Haloferax alexandrinus* is found to grow at 25 % NaCl concentration and produce PHA, and exopolysaccharide.

Natural product chemistry

Publication of Indian Medicinal plant Monographs by Indian Council of Medical Research

Acanthus ilicifolius Linn. - Leaves (Marandi)

Ailanthus triphysa (Dennst.) Alston - Stem bark (Guggula-dhup)

Anisomeles malabarica (Linn.) R. Br. ex Sims - Aerial parts (Chodhara)

Aphanamixis polystachya (Wall.) Parker - Stem bark (Rohido)

Bixa orellana Linn. - Seeds (Shendri)

Cardiospermum halicacabum Linn. - Whole plant (Kaphuti)

Datura metel Linn. - Leaves, Seeds (Kala-Dhotra)

Jasminum auriculatum Vahl - Flowers, Leaves (Jui)

Rhizophora mucronata Lamk. - Stem bark (Kandal)

Plant products

Chemical constitution of essential oil of *Swertia densifolia* leaf was identified, and used as honeybee repellent. This is first report

Semiochemicals of honeybees

Repellent formulations for Indian honeybees were developed Honeybee attractant formulations improved the efficiency of pollination in sunflower Isolation of 30 markers of medicinal plants were completed, monograph was submitted to ICMR.

Developmental biology

Developmental biology and stem cell biology

Noggin gene is required for the formation of nervous system in vertebrates we have cloned, for the first time, *noggin* gene from hydra. Since hydra shows an organized nervous system for the first time in animal evolution, this finding will provide us with important evolutionary insights by expressing hydra noggin in frog embryos, we have demonstrated the functional conservation of this gene in animals. The findings

show that molecular regulation of nervous system formation that began in hydra is conserved in vertebrates including humans

Paleobiology and paleoenvironment

Study of fossil mollusca from the Tertiary sediments of Kutch and Kathiawar resulted in identifying existence of a Lower Miocene Palaeozoogeographic Province and a migratory Route during Lower Miocene times.

ARYABHATTA RESEARCH INSTITUTE OF OBSERVATIONAL SCIENCES

Aryabhatta Research Institute Of Observational Sciences (ARIES) continued to make important scientific contributions in different front-line problems of astronomy & astrophysics and atmospheric sciences with great zeal and ebullience. Fundamental studies were conducted in the field of Astronomy/Astrophysics and Atmospheric Sciences, which include studies of aerosols, trace gases, solar activities, variable stars, star clusters, gamma-ray burst and supernova, extragalactic astronomy, etc. The major developments and academic activities carried out are summarized below:

3.6-m Devasthal Optical Telescope (DOT) Project activities are going on in full swing. The activities include design and construction of a 3.6 meter aperture optical telescope; back-end instruments, an enclosure to house the telescope, an aluminizing plant to coat the mirrors, and an auxiliary building to house the aluminizing plant, instruments and other telescope related accessories. Several scheduled activities *viz* critical design review of telescope design; acceptance of primary mirror zerodur blank at Schott Germany; award of contract and final design review of telescope enclosure and auxiliary building were successfully completed during the past one-year. The 5-year contract to design and build the telescope will complete 3 years in April 2010 and the progress during last one year has been as per the scheduled milestones in the contract. The critical design review (CDR) of the DOT has been done. After detailed discussions and review by an expert committee the CDR-stage has now been completed. A Pune based firm has been awarded a contract for design and consultancy services of the telescope enclosure and auxiliary building. A critical review of the telescope enclosure design proposed by PPS has been carried out by an expert committee. Design requirements and road map for the successful completion of the faint object spectrograph, camera and polarimeter are being prepared.

The building for 1.3-m telescope (including the telescope pier and roll-off roof) has been completed. Power supply, road connectivity and network connectivity have also been provided to the building. The

telescope house is ready for the installation of the telescope well before the arrival schedule of the telescope projected by DFM.

Building construction of the high altitude Lidar has been completed. Integration of different Lidar components is in progress. Major activity is optical alignment, which is being done.

Preliminary Design Reviews (PDR) of ST Radar is completed and design of ST radar has been frozen. It will have array of 588 Yagis of 3 elements in a circular aperture. These will be setup on the roof-top of building, which would be the first attempt in the world. The construction of building is going to be initiated soon. The T/R modules will be installed in-house. It is visualized that first batch of antenna and T/R modules will be ready soon. This proposed radar will provide continuous observations of winds with very high vertical resolution and measurements can be made in all kinds of weather.

An environmental observatory has been set up at ARIES, Nainital recently. This site will be part of three Indian background stations planned by ISRO. Apart from observations of trace gases, a complete setup for carrying out zero and span of different gases has been arranged. Importantly, these instruments are capable of measurement at very low levels (pptv).

The construction work of the Guest house 'Ashwini' and Optics Laboratory is complete. The student hostel 'Rohini' is partially completed and some of the rooms have been allotted to research students.

The Computer Centre is being upgraded further to provide facilities for high performance computing. To meet the ever increasing demand of bandwidth, the institute has procured a dedicated 10 Mbps leased line.

Academic staff members continued to pursue vigoursly their research in their respective fields. Major parts of the scientific research of the Institute were published in scientific journals of international repute (e.g. Nature, Astrophysical Journal). Fifty four papers were published/accepted in refereed journals, and another eight were published as circulars and conference proceedings. Three Ph.D. theses have been awarded and another two have been submitted. Academic and technical interactions with various institutions and universities were continued. Following are the major scientific results:

(i) It is found that the masses of the most massive stars associated with the cometary globules (CGs) are correlated with the masses of the parent cloud but they are systematically larger than expected for molecular clouds of similar masses from the relation $M_{\text{max-star}} = 0.33 M_{\text{cl}}^{0.43}$.

(ii) The global distribution of young stellar objects in HII regions clearly shows the evidence that a series of radiation-driven implosion processes proceeded in the past from near the central O star(s) towards the peripheries of the HII regions.

(iii) An extended X-ray emission in the cluster region NGC 7419 indicates the presence of ~288 T Tauri stars in the cluster region.

(iv) The *BVR* polarimetric study of the cool active star LO Pegasi (LO Peg) is presented for the first time. LO Peg was found to be highly polarized among the cool active stars. It is suggested that the level of polarization observed in LO Peg could be the result of scattering of an anisotropic stellar radiation field by an optically thin circumstellar envelope or by scattering of the stellar radiation by prominence-like structures.

(v) The presence of supernova signature in long-duration GRB afterglows has further strengthened the fact that the collapse of a massive star gives rise to long-duration GRBs.

(vi) A possible correlated variability between X-ray and J band (1.25 μ) near infrared (NIR) wavelength has been obtained. This is the first case of X-ray and NIR correlated variability in Mrk 421 or any high energy peaked blazar. The correlated variability indicates a similar origin for the NIR and X-ray emissions.

(vii) The multiple sausage oscillations have been observed for the first time in the cool post flare loop.
(viii) Influence of the dust transport from Thar Desert to the Central Himalayan region was shown for the first time. This region is shown to be generally much less polluted and the photochemical ozone production is not significant, except during events of long-range transport and fires.

The Institute organized India-South Africa workshop on Astronomy to strengthen the scientific collaboration between the two countries. A summer school on introductory Astronomy, Astrophysics and Atmospheric sciences was held for M. Sc. (Physics) students which aimed at introducing fundamentals of the subjects to motivate them for basic research.

The Institute has a vibrant graduate studies programme with more than twenty research students. The institute continued to host a variety of programmes for man-power development through (i) research and engineer trainee programmes, (ii) projects as part of academic course work, (iii) visits of students and staff from other institutions, and (iv) summer project student programme.

Several public outreach activities took place during the year including National Science Day which had several exhibitions, talks and viewing of the night sky. ARIES executed a project to set-up an eleven inch diameter optical telescope at St. Joselph's College, Nainital for educational purpose. This project was funded under MPLAD scheme of Dr. K. Kasturirangan, Honorable Member of Parliament.

A number of scientists and engineers of the Institute participated in national and international conferences/ workshops/colloquia with invited and/or contributed presentations.

A number of young and meritorious scientists and engineers have joined ARIES. ARIES faculty members are actively collaborating with scientists and engineers of other institutes in India and abroad. The continued developments in infrastructure and academic activities at the Institute indicate bright future of the Institute.

Spatial distribution of Class 0/I sources (green circles) and Class II sources (pink circles) in the BRCs 13 and 14 region identified in the *Spitzer*/IRAC data.

Assembly and testing of 50-cm B-N Schmidt telescope at M/s Pedvak, Hyderabad.

Foundation stone laying of 3.6-meter Devasthal Optical Telescope House by Dr. T. Ramasami, Secretary, DST, Govt. of India on September 06, 2008.

BIRBAL SAHNI INSTITUTE OF PALAEOBOTANY

Areas of Research Focus of Birbal Sahni Institute of Palaeobotany, Lucknow are as follows:

The Institute is working with the following aims and objectives:

- To develop Palaeobotany in all its botanical and geological aspects
- To constantly update data for interaction with allied disciplines
- To co-ordinate with other palaeobotanical and geological research centers in the areas of mutual interest, such as diversification of early life, exploration of fossil fuels, vegetational dynamics, climatic modeling, conservation of forests, and
- To disseminate palaeobotanical knowledge in universities, educational institutions and other organisations.

Institute is carrying out significant work on fundamental and applied aspects of the Palaeobotany. This is the only centre in the world where Palaeobotanical researches are being conducted right from Archaean to Recent in age ranging from 3200 my to 400 AD which includes the archaeobotany and tree ring analysis for the evaluation of climate change.

The Institute is devoted to develop both fundamental as well as applied aspects of Palaeobotany, for its future growth in the right direction, by adopting an integrated and multidisciplinary approach, coordinating with other national and international knowledge centers of mutual interest.

For further improvement of Institute's Publication profile and also for the establishment of its value as a science useful for society, several steps have been taken through participation in meetings, seminars, conferences and having collaborative scientific programmes.

Scientific Collaborations

International Collaborations

- Institute of Botany, Chinese Academy of Sciences, Beijing, China: Cenozoic vegetation and climate changes in China and India and their response to the Himalayan uplift.
- Institute of Geosciences, University of Sao Paulo and Guarulhos, Brazil: Palaeobotanical studies on Indian and Brazilian sedimentary basins.
- Initiation of collaboration with University of Texas, USA for the study of Antarctic Gondwana plant fossils.

National Collaborations

- Wadia Institute of Himalayan Geology, Dehradun: Precambrian palaeobiology (Early Life), Floristics & biostratigraphy of palaeozoic-Cenozoic successions and Quaternary palaeoclimate of Himalayan region.
- Geological Survey of India (Coal Wing), Kolkata: Palynology, floristics and coal petrographyof selected lower Gondwana Coal basins.
- Delta Studies Institute, Vishakapatnam: Quaternary palynology and palaeoclimate of K-G Delta.

- National Institute of Oceanography, Goa: Palaeoclimate of marine and coastal areas.
- National Centre for Antarctic and Ocean Research, Goa: Multidisciplinary integrated study on Antarctica, Arctic and southern ocean palaeoclimate based on palynology, palynofacies, phytoplankton, clay mineralogy & rock magnetism of lake and marine sediments.

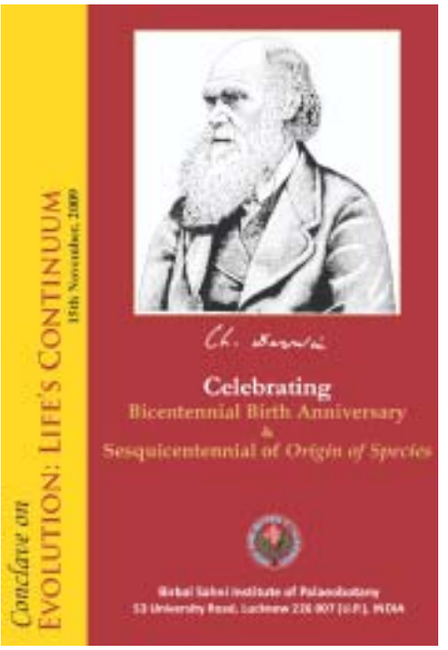
Assistance to Industry

Keshava Deva Malaviya Institute of Petroleum Exploration (Oil and Natural Gas Corporation, Dehradun): Palaeobiological studies from the Ganga Basin and their biostratigraphic correlation with Tertiary type section of Garhwal Himalaya revealed some significant results that give lead to Hydrocarbon Exploration Research in the Ganga Basin. Technical Report is under submission to ONGC.

Conferences Organized

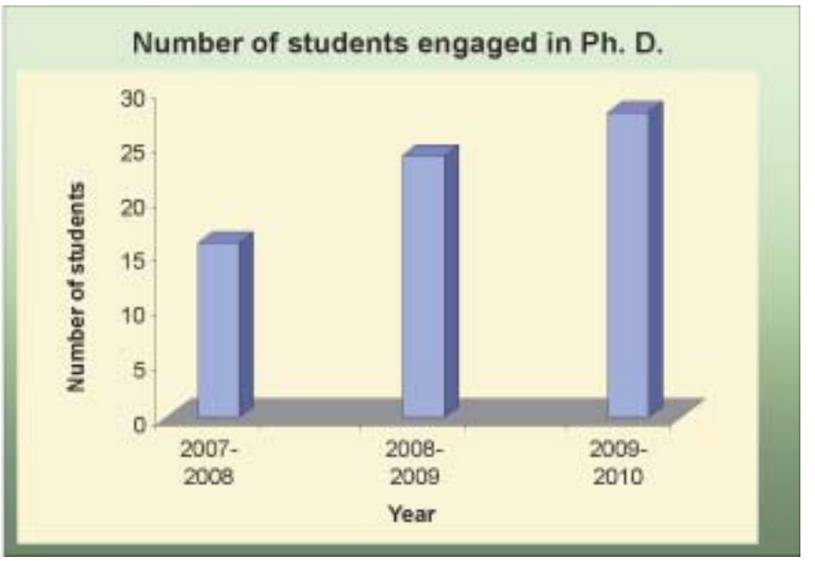
The Institute recently organized two thematic conferences:

- *"Climate Changes during the Quaternary: Special reference to Polar Regions and Southern Ocean"* during 22-23 October 2009 (jointly with NCAOR at Goa).
- Conclave on *"Evolution–Life's Continuum"* on 15 November 2009 for celebrating Bicentennial Birth Anniversary & Sesquentennial of *Origin of Species*.



Human Resource Development

BSIP is the recognized as a research centre of Lucknow University and the Senior Scientists are authorized to work as Supervisor for Ph. D. degree. The young scholars are working under Birbal Sahni Research Scholarship, Birbal Sahni Research Associatesship and in number of sponsored projects. At present 28 scholars are working for their Ph.D. degree and the number of Research Students are significantly increasing.



Training Programmes

- Specialized Training Programme was organized for newly recruited young research scholars, associates and scientists on basic knowledge of Geology and Field training programme in collaboration with Palaeontological Society of India, Lucknow.
- Training programme on "Concepts in Quaternary Climate Studies with emphasis on Dendrochronology and Palynology" has been organized in collaboration with Colorado State University, USA.
- A training programme on Sequence Stratigraphy has been organized by the Institute in October 2009 (with Department of Geological sciences, Jadavpur University, Kolkata).

Highlights of Research Achievements

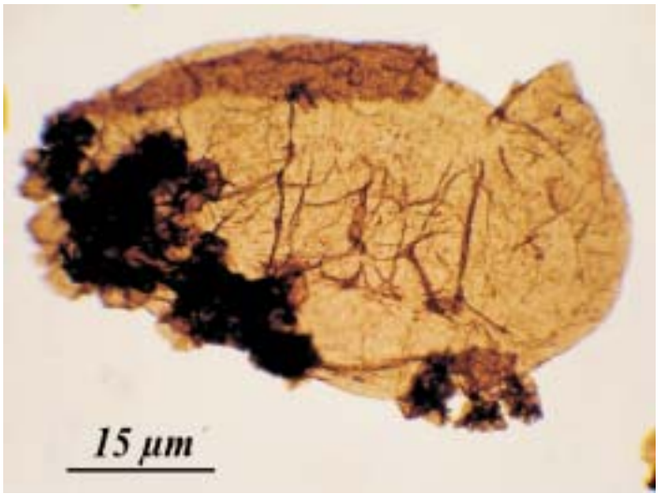
For achieving the targets of the XI Five Year Plan, 14 research projects for the year 2009-2010 have been organized under the umbrella of six identified Trust Areas:

- Early life, atmosphere and oceans: Evidences from Indian Craton (Bio-Geosphere interactions in the Precambrian).
- **Fossil land plant communities:** Morpho-structure, Evolution, Systematics with applications to Biostratigraphy and Palaeoecology (Plant evolution, Anatomy, Taxonomy and Stratigraphy).
- **Integrative Micropalaeontology, Biopetrology and Organic facies:** Relevance to fossil fuel characterization and exploration (Integrated approach to realizing economic potential in prospective basins).
- **Multi-proxy parameters for Quaternary palaeoclimate reconstructions**: vegetation dynamics, relative sea level changes and anthropogenic influence (Integrated approach to climate change, modeling and sustainable ecosystems).
- **Polar and Major Planetary Events** (Polar research and record of events such as Tsunami, Earthquakes and Volcanism).

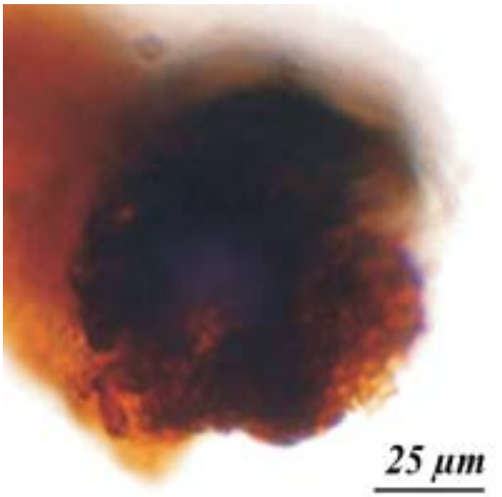
- **Frontiers in Palaeobotanical Research** (Reconnaissance Projects to aid in development of future research direction).

Some Significant Outcome of Scientific Research in BSIP

First record of Type I matured, Litinite Organic matter facies from the Gotan Limestone (Neoproterozoic approximately 1000-542 Ma) in Rajasthan throws open an entirely new basin for hydrocarbon exploration from the Neoproterozoic sediments in Rajasthan and other similar prospective basins in India.



Leosphaeridia jacutica



***Gloeocapsamorpha* sp.**

- **Studies on diatoms, palynofacies and calcareous algae:** Studies on plant fossils from some Permian Gondwana sequences of MP and Cretaceous sequences of South Rewa Basin and East Coast (Krishna-Godavari Basin) have been carried out in order to decipher the palaeoclimate.
- Documentation of spores-pollen assemblages from certain coal-bearing sequences of Peninsular India have been continued to demarcate their significance in biostratigraphic and coal seam's correlation and to deduce palaeodepositional history.
- To generate additional data on plant mega- (leaf, wood, fruit, etc.) and micro remains (pollen, dinocysts, nanno, DOM, etc.) investigations have been carried out from the terrestrial and marine Palaeogene horizons of MP, Maharashtra, Gujarat, Uttarakhand, WB and Assam in terms of their palaeogeographic, facies and palaeoenvironmental significance, besides morphotaxonomy.
- Studies on dinocyst and palynofacies assemblages from the Meghalaya have been continued to understand palaeoecological and relative sea level changes associated with major biotic and climatic events.
- In relation to their palaeoecological significance during Cenozoic sedimentation in Andaman-Nicobar basin have revealed some significant results for deciphering palaeoenvironment and bathymetry.
- To decipher the chronology of palaeoclimatic changes during Quaternary Period on the basis of palaeovegetation through palynology of continental and marine sediments, tree-rings, and ancient plant economy, supported by geochemistry and geomagnetic studies have been carried out.

- Certain Permian coals (Godavari Basin) and Tertiary lignites from Gujarat and Tamil Nadu have been evaluated for categorization of their economic suitability besides their depositional history.
- Parameters for past global changes have been marked using significant multidisciplinary data generated from Late Quaternary sediments of Mahanadi and Godavari Deltas, Karawar Coast, south-western MP, Kumaun & Ladakh Himalayas, and Upper Assam.
- Evidenceone of the (12,960 ±130 yrs BP) mangrove environments in SE Asia from Mahanadi Delta has been recorded.
- Significant multi-proxy data have been generated on the Quaternary sedimentary samples collected during Antarctic and Arctic Expeditions to envisage climate changes.
- Studies have been carried out in resolving age of Neyveli lignite deposits; in establishing Carboniferous strata in Spiti Himalayas; and searching plant remains in Kargil Mollasse; based on integrated palaeobotanical/ palynological evidences.

Publications: 79 (includes published, accepted and communicated papers).

Impact Factor Aggregate: 52.493 (date, includes published, accepted and communicated papers).

Number of Research faculties (post-Doctoral): There are 58 scientists and 52 scientists are having post-Doctoral research experience.

BOSE INSTITUTE

Improvement of Plants: Biotechnological Genomic, and Proteomic Approaches

Plant DNA Fingerprinting and Diagnostics of Medicinal Potential in plants; Identification of defense related genes from S. alba on infection with A. brassicicola; Production of transgenic rice plants over expressing rice cDNAs for SAM-decarboxylase, Rab16A, the transcription factor OSBZ8 (the ABRE cis-acting element binding factor), OsMII BP (the Rab16A gene motif Iia cis-acting element binding protein), and the sodium chloride and spermidine activated probable kinase OSPDKI has been continued; Understanding the mechanism of seed dormancy, viability and germinability of plants of economic importance; Resistance gene analogue profiles, generated by degenerate RGA primers, of a set of 30 rice landraces of West Bengal is being used for genetic diversity analysis; Analysis of *cis*-regulatory elements for *PcINO1* gene: Search for any putative "salt regulated promoter elements" of the gene which can be used to upregulate certain other important salt-tolerance genes under transgenic situation; Efficacy of the aphid tolerance gene(s) being tested in the model plant and *Brassica* species through transgenic approach; Genetic diversity analysis of bamboo species is being conducted in and around West-Bengal using molecular techniques; Aerobiological survey in both indoor and outdoor environments; Isolation of new insecticidal proteins and their characterization using biochemical and biophysical techniques; Designing of new lectin molecules through site directed mutagenesis of the already established insecticidal lectins to broaden the pathogen specificity; Development of effective micropropagation protocols to speed up propagation rate of rare/ endangered/ commercially important medicinal plants species.

Protein Structure, Function and Engineering

Structure of the λCII-DNA complex: The full-length CII protein is being cocrystallised with an oligonucleotide (~18 bp) containing the cognate CII recognition site. The structure will be solved by X-ray

diffraction and molecular replacement based on the CII structure; crystallography, NMR, proteolysis and mass spectroscopy and 2D gel electrophoresis to be used for various studies involving these; The structural and mechanistic aspects of antimitotic drugs binding to tubulin; Identification of functional regions of ?-crystallin chaperone; Protase digestion studies of lambda cl repressor; Structural and functional analysis of a truncated amino acyl tRNA synthetase Glu-tRNA synthetase from *E.Coli*; Analyzing the interaction between HP0175, a peptidyl prolyl cis,trans isomerase of Helicobacter pylori and Toll-like receptor 4 (TLR4).

Bioinformatics and Computational Biology

An evolutionary perspective of gene expression level and protein secondary structure; Evolutionary studies of isochore organization in warm-blooded vertebrates; Electrostatic Interactions in Biological Systems; Identification of protein surface that is used for protein-protein interaction; Three dimensional models of type IV pilins in some enteropathogenic organisms like enterotozxigenic E.coli and enteropathogenic E.coli ; Assignment of substrate specificity of phylogenetically diverse aromatic ring-hydroxylating dioxygenases by computational analysis.

Molecular Medicine

Regulation of ion transporting enzymes and protein kinases by endogenous modulator proteins; Synthesis of the peptides corresponding to these sequence of the modulators, check the activity of the synthetic peptide(s), so that instead of isolated proteins, synthetic peptides can be used; Effect of the bio-active molecule [active principle(s)] on the prooxidant/ anti-oxidant status; Manipulation of specific molecular targets to suppress survival program of cancer cells; Molecular engineering-based therapeutic strategy to regain pro-apoptotic program of cancer cells; Molecular mechanisms of cell cycle regulation in normal and cancer cells; Molecular understanding of the role of oncogenic *Ras* in cancer progression; Evaluation of thyroid hormone– aminergic involvement in maintenance of the "Central Homeostasis for Thyroid Hormone"; Lipid rafts and their implication in infectious diseases: Developing diagnostic tools for tuberculosis; Molecular characterization and application of some important herbal medicine from terrestrial and marine sources to combat nearly non-curable diseases such as viral, cancer and other autoimmune diseases.

Microbial Genomics and Infection Biology

Role of E. coli galP3 promoter; CCRs and VL: their involvement on the interplay of Th1 and Th2 cytokines; Use a functional genomics approach of down regulating sequence homologs of known cell cycle regulators using RNA interference; Study the effect of down regulating CDKs, cyclins, kinesins and forming homology proteins using shRNA; Genomic and proteomic approaches towards understanding the biology of Mycobacterium tuberculosis; Stress-responsive genes/ proteins and mycobacterial persistence; Using fluorescent *S. aureus* strains already developed, sensitive assay systems are being developed followed by the screening of antibacterials from plants; Biochemical characterization of development of microbial process(s) for the efficient mineralization of various health hazard environmental pollutants; Understanding replication mechanisms of a mycobacterial plasmid; Functional genomics of S-phase DNA repair and DNA replication checkpoint pathways in the budding yeast.

Development of Systems Biology

Activation of the stringent response regulator Rel in mycobacteria by positive feedback and gene expression noise.

Basic and Applied Problems in Physical and Environmental Sciences

To unveil newer applications of environmentally benign solids as catalysts; Conformational Equilibrium in Mesogenic Molecules; Understanding the physics of nucleation of superheated droplets:**;** Characterization of passive detection material for heavy ion detection & search for strangelets at high altitude; High energy Nuclear Physics; Conductivity and dielectric relaxation in complex perovskite oxides; Duality in Entanglement and Probing Quantum to Classical Transition of Indistinguishability; Linking Foundation of Quantum Mechanics with Cosmological Aspects and General Relativity; Quantum Entanglement in Spin and Other Condensed Matter Systems; Environmental chemistry, measurements of pollutants and source strength modeling. Radiometric measurements: study of rain drop size, rain height and other cloud characteristics, cloud-aerosol – cosmic ray connection – modeling.

INTERNATIONAL ADVANCED RESEARCH CENTRE FOR POWDER METALLURGY & NEW MATERIALS (ARCI)

Nanomaterials

The Centre for Nanomaterials originated from ARCI's Powder Metallurgy Division, which was in existence since inception of ARCI. The concept of establishing the Centre for Nanomaterials took shape in the year 2003. Considering the fact that ARCI had outstanding expertise in the area of materials, it was decided that ARCI would concentrate on the production of nanopowders and also explore on its own their utilization for at least some applications which cater to either a large Indian market or a market unique to India. Within past seven years, the Centre has made substantial progress in terms of not only establishing a vast array of synthesis, processing and characterization facilities, but also in moving significantly forward towards application development in the several promising areas including nanosilver for drinking water disinfection and highly stable nanosilver suspensions for antimicrobial textile applications.

Nanosilver-candle filter technology has been successfully transferred to a company and the product is in market with the brand name PURITECH. Prior to technology transfer, the product underwent field trials for a year in about 40 villages for drinking water disinfection and was tested in the laboratory as per IS and EPA guidelines. The company is already operating a production facility based on ARCI technology with capacity of 1000 candles per year.

Transfer of know-how pertaining to nanosilver for antimicrobial textile applications to a company is in final stage. Nanosilver technology for textile application has been scaled up to pilot level successfully for a technology receiver dealing in the field of textiles.

Laser Processing of Materials

Centre for Laser Processing of Materials (CLPM) at ARCI is a unique R&D facility in the country based on high-power industrial lasers. The Centre's main objective is to promote and provide laser-based materials processing technologies for industrial application.

Major facilities available at CLPM include Fiber-Coupled Diode Laser, CO_2 Slab Laser and Pulsed Nd:YAG Laser.

Few typical applications developed at CLPM are given below:

Laser Welding Applications

- Automotive body parts made of tailor welded blanks (TWB)

- Door inner after forming the laser welded TWB
- Solenoid valve
- Fast response thermometer
- Flex Plate with Laser welded SAW Sensor Buttons
- Transverse section of laser welded Ni-based superalloy IN 718
- Microstructure of fusion zone of laser welded Ni-based superalloy IN 718

Laser Surface Modification Applications

- Laser-Hardened edge of crankshaft
- Laser hardened automotive crankshafts
- Laser hardened automotive camshaft
- Laser surface treatment of railroad components
- Laser surface clad Stellite-6 layer
- Laser surface alloyed Colomnoy-88 Layer
- Laser-Clad coated 500-MW Burner Tip Nozzle Plate
- Laser glazing of plasma sprayed WC-Co layer

Laser Cutting Applications

- Laser cutting of combustion liner
- Laser cutting of maxillofacial and dental titanium implants
- Laser cut edge of 1.6 mm CP titanium

Centre for Fuel Cell Technology (CFCT)

ARCI's Centre for Fuel Cell Technology (CFCT) established in Chennai specifically contributes to national efforts in this emergent field. Although mandated to develop the Polymer Electrolyte Membrane (PEM) fuel cell technology, CFCT has geared up to play a key role in varies aspects of the hydrogen economy. Since its inception in 2004, CFCT has made considerable progress and has been at the forefront of developing PEM fuel cell technology for stationary and transportation applications in the country. During the previous years, CFCT had developed key technologies for various fuel cell components and demonstrated stack building capabilities. Recently, CFCT has developed fuel cell electrodes which can operate under low humidity conditions. Several fuel cell stacks have been built using these electrodes. Significant progress has also been made in identifying and developing suitable Balance of Systems (BoS), which include radiators, fans, pumps, DC-DC converters and invertors. The Centre has also developed Grid Independent Power Systems (GIPS) for various power ranges from 300W to 5kW. CFCT has also continued to make improvements in the process for making bipolar plates from exfoliated graphite. Fuel cell stacks were built using these bipolar plates and it is observed that the weight reduction was about 54% compared to the graphite based stacks of similar dimensions. The centre has also developed fuel cell

stacks for range extension of electric three wheeler vehicle. The electric vehicle has achieved the targeted range extension of 17 kms for the hydrogen available and the weight carried in the vehicle. The Centre is further planning to make a light weight fuel cell stack with exfoliated graphite plates aiming at 50% reduction in weight. This is expected to result in range extension of 25 kms.

Micro Arc Oxidation (MAO) Technology:

MAO, also known as Plasma Electrolytic Oxidation, Spark Anodization or Micro Discharge Oxidation is a novel electrochemical coating technology gradually gaining increasing popularity as a unique technique capable of demonstrating ceramic coatings on metals like Al, Ti, Mg and their alloys. The MAO process differs radically from the traditionally known anodizing/ hard-anodizing in several ways. It employs AC power at high voltages (150-700 V) and high current densities (0.1 – 0.3 A/cm2) and utilizes an alkaline electrolyte at around room temperature. In addition, the MAO process is capable of depositing dense and ultrahard ceramic coatings on all kinds of aluminum alloys without any restriction on the concentration of the alloying elements. Yet another important difference between the aforementioned traditional processes and MAO is the latter's eco-friendliness. By virtue of these distinctive features, the MAO process has gained global attention and research groups in countries like USA, UK, Russia, France and China are actively working on MAO technology. In India, ARCI has taken the lead to develop this technology concurrently with the rest of the world.

ARCI has already transferred the MAO technology to 3 companies located in different parts of India.

Papers Published

Several papers were published by the scientists of the Centre in various journals of international and national repute.

Patents Filed

- H. Neha and Tata N. Rao, "Improved method of producing highly stable aqueous nano-titania suspension" Indian patent application filed. Appl. No. 730/DEL/2009
- The patent entitled "Fluoride Removal from Ground water by Sol Gel gamma Alumina Coated Ceramic Honeycombs" is being filed jointly with NCCCM, (DAE), Hyderabad
- "Novel Copper Foils having High Hardness and Conductivity and a Pulse Reverse Electrodeposition Method for their Preparation", B. V. Sarada, Ch. L. P. Pavithra, M. Ramakrishna, T. N. Rao and G. Sundararajan. Patent Application No. 1028/DEL/2009, Date of filing: May 20, 2009

Interactions with Industry to Explore Technology Transfers

- Interactions are ongoing with Hyderabad-based Electrical Company for a project on Slip casting of Zirconia based nozzles.
- Negotiations are on with an Indian company for exploring the possibility of transferring the technology for the synthesis of ultrafine zirconia powders for pigment applications.
- Interactions are ongoing with Indian companies for technology transfer pertaining Nano-ZnO based varistor powders.

Sponsored Projects being initiated

- Developmental Project entitled "Sol-gel derived abrasion resistant hydrophobic coatings on carbon-epoxy composites for aerospace applications" has been sanctioned by National Aerospace Laboratories
- A project on "nanostructured Si and Sn based anode materials for Li-ion batteries" has been initiated in collaboration with a premier automotive company from USA.

A project entitled, "Laser Drilling of Holes on Front Combustion Liner of Adour MK 871 Engine", has been approved.

INDIAN INSTITUTE OF GEOMAGNETISM

The Indian Institute of Geomagnetism (IIG) has the mandate to carry out basic and applied research in Geomagnetism and allied areas of Atmospheric and Space Plasma Physics. The Institute has established various facilities to measure the geomagnetic field, atmospheric and ionospheric parameters, and other related observations at its magnetic observatories located in different parts of India, its two regional centres at Equatorial Geophysical Research Laboratory (EGRL) at Tirunelveli, and the Dr. K. S. Krishnan Geomagnetic Research Laboratory (KSKGRL) at Allahabad, and at the Indian Antarctic Station at Maitri. The data from these observations are used to study not only Earth's upper atmosphere, ionosphere, the global electric circuit and certain aspects of the solar-terrestrial relationship, but also main magnetic field generated in the deep interior of the Earth. Geomagnetic data is supplied to scientists from other institutions for use in their research, as well as to other organizations for use in geophysical exploration. A variety of data is also collected during geophysical surveys in different parts of India. Rock and sediment samples acquired from different regions are studied in the palaeomagnetic laboratory at KSKGRL and the environmental magnetism laboratory at IIG's headquarters in Panvel.

Observatories and Data Processing

The Institute continued to operate, upgrade and maintain ten magnetic observatories in the country to ensure continuous recording of high quality geomagnetic data. Construction of Variometer room, office building, and approach roads at the new location of Silchar magnetic observatory, as well as of the observatory functional building at Port Blair is nearing completion. Near real-time transmission of geomagnetic data at one minute time resolution, from three observatories at Pondicherry, Alibag, and Jaipur respectively, to the Institute headquarters in Navi Mumbai, has been achieved in 2009. Near real-time connectivity with Nagpur observatory has also been established recently.

Indian Magnetic Data bulletins for the years 2006 and 2007 have been published, while geomagnetic data, corrected for baseline errors up to September 2008, are available to users in computer readable form. One minute resolution absolute values for 2008 obtained from the International Real-time Magnetic Observatory Network (INTERMAGNET) facility at Alibag, have been deposited with the Geomagnetic Information Node (GIN) at Paris for inclusion in the Annual CD-ROM publication.

Processed hourly data of H-component of the geomagnetic field from Alibag station are sent to Kyoto GIN every month for the preparation of the Dst index, which is used globally as a measure of the strength of magnetic storms. Principle magnetic storm days are classified regularly using magnetograms of Indian stations and magnetic storm sudden commencement amplitudes and ranges are computed every month and forwarded to World Data Centre (WDC), Colorado, for inclusion in the international Geophysical

Data Bulletin. In addition, about 240 remote users are registered with the website of WDC, Mumbai, for access to online data bases available with this WDC maintained by IIG.

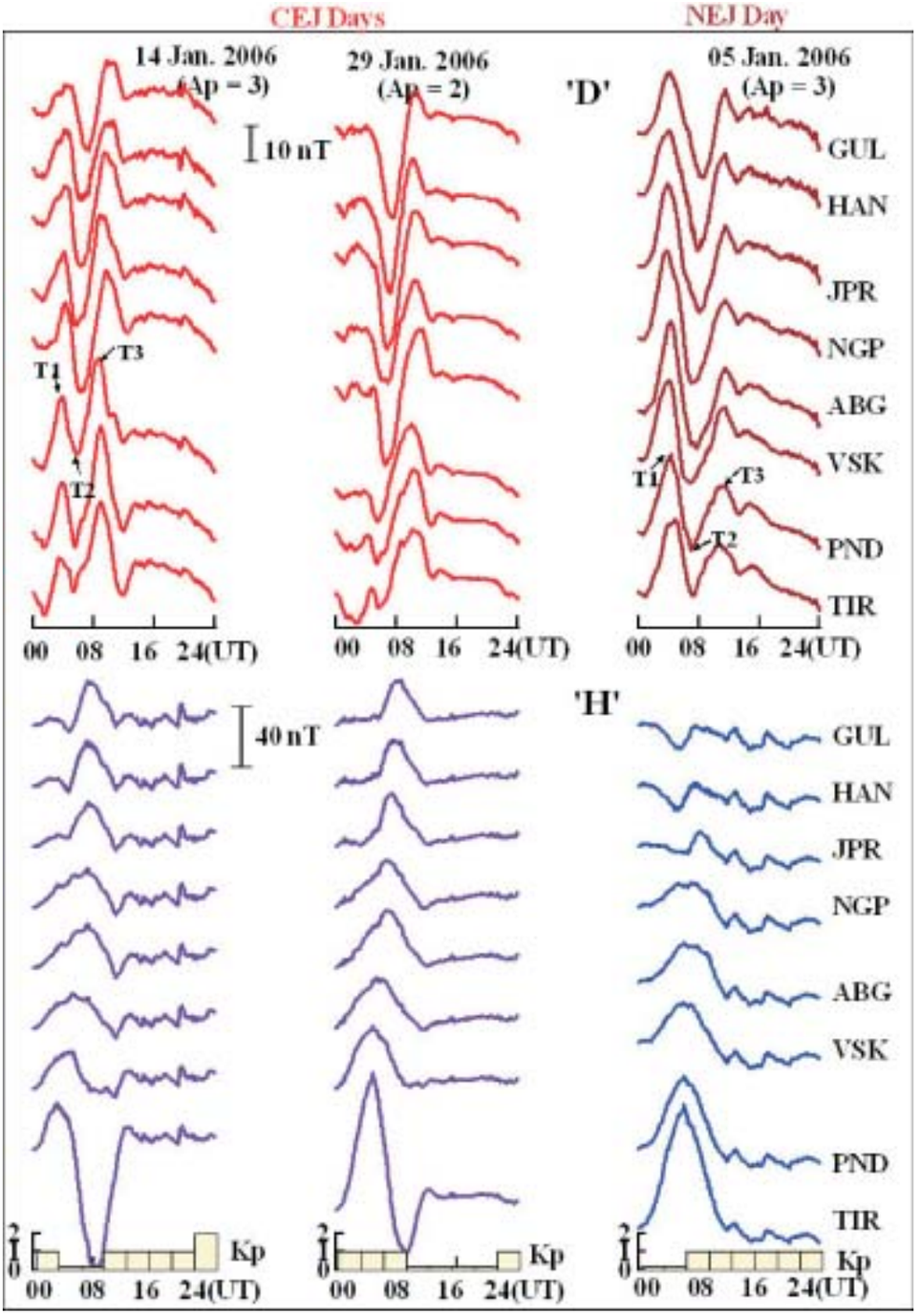


Fig. Association between the equatorial electrojet current pattern and the noticeable changes in the latitudinal development of the focus of the solar quiet day (Sq) current system is shown here. Significant day to day variability in the geomagnetic field influenced by the modification of the tidal modes is clearly evident in the diurnal features for the two Counter Electrojet (CEJ) days and a Normal Electrojet (NEJ) day.

Of the various investigations carried out with geomagnetic data, an important one relates to the day-to-day variability in the geomagnetic field caused by changes in ionospheric currents in response to variations of the atmospheric tides. This has been investigated by analyzing the changing solar quiet (Sq) current patterns on a day-to-day basis. The changes, as reflected in the variations of the horizontal component 'H' and declination 'D' of the geomagnetic field at the chain of low latitude locations in India, are studied in the context of varying equatorial electrojet current pattern (Fig). Contamination of the quiet time field variations from distant magnetospheric currents is also examined.

ELF/VLF electromagnetic waves radiated by both natural (e.g., lightning discharges) and man-made (e.g., VLF transmitters) sources, are reflected from ionospheric D-region to travel very long distances in the Earth-ionosphere wave guide with very little attenuation. Thus VLF waves are used to study the ionospheric D-region, which is at a height that can neither be accessed by balloon probes, nor by satellites. Reasonable measurements can not be made by radars also because of low electron density. At present in collaboration with Stanford University, three VLF receivers have been set up by IIG at Allahabad, Varanasi, and Nainital. A special campaign to monitor the changes in the D-region of the ionosphere during 22 July, 2009 total solar eclipse was carried out at the three sites.

Antarctic Studies

The Institute participates regularly in the Indian Antarctic Expeditions with the objective of studying the geospace environment of Antarctica using multiple techniques. A semi-permanent observatory is operated at Indian Antarctic station, Maitri, located in sub-auroral region where variations in geomagnetic field are recorded by using fluxgate and proton precession magnetometers.. Geomagnetic field is also monitored at Larsemann Hills, the proposed new Indian Antarctic station in a campaign mode during austral summers. Magnetic data is used to study magnetic storm-substorm relations and to investigate declining magnetic field. Particle precipitation is generally a high latitude phenomenon and is seen in polar and auroral regions. During geomagnetic disturbances, the auroral current system extends over Maitri and particle precipitation over this region is expected to increase electron density in ionospheric D-region resulting in greater absorption of HF and VHF radio waves. IIG has installed a 4 x 4 antenna array imaging Riometer at Maitri during this year to monitor the ionospheric absorption of cosmic radio noise at 38.2 MHz.. A part of the southern hemisphere has suffered a large decrease in the total magnetic field in the last century.

Upper Atmospheric Sciences

Nonlinear electrostatic solitary waves have been studied for a plasma model consisting of cold and counter streaming electrons and ions using multi-fluid theory. Parameters for the model are obtained from the Cluster satellite observations in the Earth's magnetosheath. It is found that the model results are in good agreement with observed electric field structures. Evolution of electrostatic solitary waves in the auroral region is studied using a one dimensional electrostatic particle simulation code, and the simulation results for velocities, scale sizes, and electric fields associated with nonlinear electric field structures are found to be in agreement with the observations.

Various nightglow emissions have been monitored using ground-based high resolution airglow equipments (All-sky imager, all sky scanning photometer) at Kolhapur, Allahabad, and Tirunelveli to study the dynamics of the mesosphere- lower thermosphere (MLT) region and ionospheric F-region on clear moonless nights.

The medium frequency (MF) partial reflection radars operated by IIG at Tirunelveli and Kolhapur continued to yield important data for understanding the dynamics of the MLT region and atmospheric-ionospheric coupling. Several new findings on the effects of sudden stratospheric warming events on the equatorial ionosphere were published.

Solid Earth Geomagnetism

Magnetotelluric data collected in the close vicinity of the eastern syntaxis (Arunachal Pradesh), under an agreement with the National Hydroelectric Power Corporation, were interpreted and the final report on the major fault zones was submitted. These studies cover the Main boundary thrust (MBT) and the main frontal thrust (HFT) of the Himalaya and the Mishmi thrust (MT) in the Indo Burman range (Figure) and have delineated the signatures of these features at the deep crustal levels. These details are useful in assessing the seismogenic potential of these features when correlated with the depth of foci of the seismic events recorded in this region.

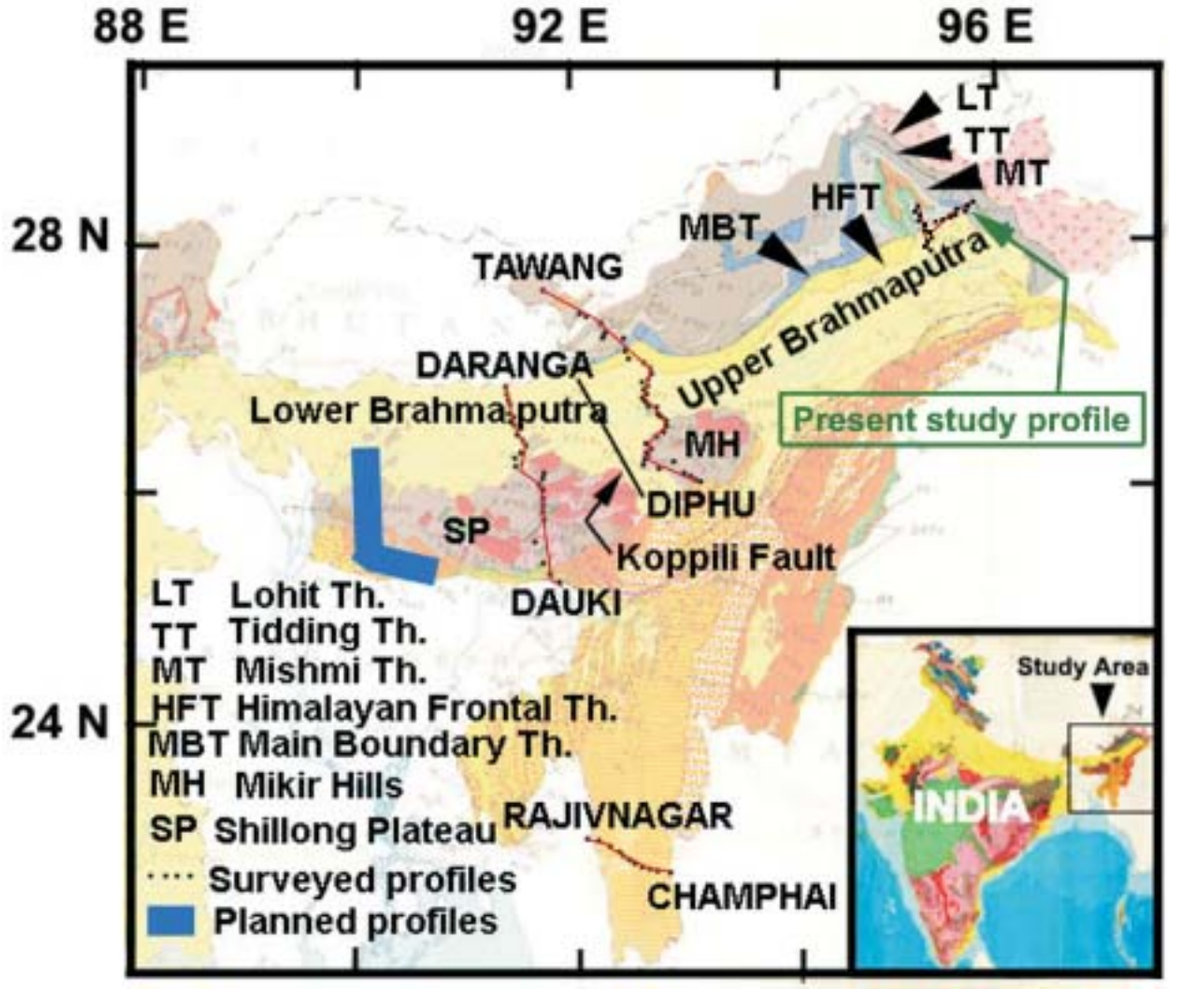


Fig. Geological map of the Eastern Himalayan syntaxis showing the magnetotelluric transects in the NE Indian region. Also marked here are the major tectonic features.

The alkaline syenite bodies of Proterozoic age, intruding into the Nallamalai Fold Belt of Cuddapah Supergroup along deep faults and fault intersections which are postulated to have crystallized from mantle derived hydrous alkaline magma enriched in LIL and LREE are subjected to low field anisotropic magnetic susceptibility (AMS), rock magnetic and palaeomagnetic measurements to understand the magma intrusion mechanism and their palaeomagnetic age. Presence of syenite bodies along the eastern margin of Cuddapah Basin suggests that it is a zone of plume-rift interaction.

The environmental magnetism group has been involved in two palaeoclimate studies. The first of these attempts the reconstruction of last glacial to early Holocene monsoon variability from relict lake sediments of the Higher Central Himalaya in Uttarakhand. The second study deals with the reconstruction of the variability of the southwest monsoon during the past 3 ka, using samples from the continental margin of the southeastern Arabian Sea.

GPS data from north-east Indian region has been analyzed to estimate present day crustal deformation strain distribution of north-east India due to the Indian plate kinematics. Post-seismic deformation and rheology of Kutch region following the 2001 Bhuj earthquake has been studied using GPS, gravity and InSAR measurements. Visco-elastic relaxation modeling of Andaman-Sumatra region has been carried out to delineate post-seismic deformation mechanism due to the 2004 Sumatra earthquake.

Regional geomagnetic depth sounding (GDS) experiment was carried out in Saurashtra region in two phases which suggests the presence of two prominent conductivity anomalies. The first elongated anomaly coincides with the horst and graben offshore structures of Saurashtra and Kutch. The second anomaly is over the Surat depression and correlates very well with the low magnetization anomaly which extends in NE-SW direction towards Cambay basin.

The possible geothermal sources for three hot springs in Ratnagiri district of western Maharashtra: Aravali, Tural and Rajawadi, were studied using vertical electrical resistivity soundings (VES). The spatial distribution of the apparent resistivity of all the five VES sounding points indicated a low apparent resistivity at all depths, coincident with the location of Tural and Aravali hot springs.

Instrumentation Division

The instrumentation division fabricated microcontroller based proton precession magnetometer of 0.1 nT sensitivity for installation at 3 magnetic observatories of the Institute. A declination-inclination (dIdD) Vector Proton Magnetometer was fabricated and set up at Alibag magnetic observatory to collect data at 1 minute sampling rate.

Publications

The scientists in the Institute published 35 papers in SCI and 15 in non-SCI journals with a total impact factor of 61.554. One PhD was also awarded.

Specialized services offered

Indian Magnetic Data was supplied to International organizations and institutes & universities in India and abroad. Digital geomagnetic data for 3 stations for selected periods at one minute time resolution was sold to ONGC Dehradun, data for 2 stations was sold to Reliance Industries and to three multinational companies involved in marine magnetic surveys. Magnetic compasses of Indian Navy, Pawan Hans Helicopter Ltd., Indian Coast Guard Air and Instrulab were calibrated.

Collaborative research and technology development Projects

The Institute has signed MoUs with Assam University, Silchar, for IIG's magnetic observatory, with Shivaji University, Kolhapur, for on-going collaboration in the area of space physics, with Saurashtra University, Rajkot, for magnetic observatory and scintillation observations, with ARIES, Nainital for collaboration in the recording of ELF-VLF electromagnetic waves, with .Department of Physics, Banaras Hindu University, for collaboration in the recording of ELF-VLF electromagnetic waves and NARL, Gadanki, for setting up of spaced receiver scintillation experiment.

Institute also has projects with foreign partners like STAR Laboratory, Stanford University, USA, GeoForschungsZentrum Potsdam, Germany, Space Environment Research Center, Kyushu University, Japan, Boston College and Air Force Research Laboratory, USA (IHY/UNBSSI Program) and Lancaster University, UK.

RAMAN RESEARCH INSTITUTE

The Raman Research Institute was founded by Prof. C.V. Raman. After his demise in 1970, it was reorganised as a national institute for research in basic science. The Institute has been receiving grants from the DST since 1972. The main fields of research continue to be, Astronomy & Astrophysics, Light & Matter Physics, Soft Condensed Matter and Theoretical Physics.

The Liquid Crystals research has expanded and diversified and is today the Soft Condensed Matter research theme that includes inter-disciplinary soft condensed matter and biological physics, which has a significant overlap and interaction with the Theoretical Physics activity. In addition, laboratories in the theme of Light and Matter Physics are making experimental studies in the emerging fields of laser cooling and trapping of atoms and molecules, light propagation in diverse media, and ultra-fast atomic processes using femtosecond (10^{-15} s) laser pulses.

The Institute considers the transmission of knowledge an important activity; this includes the guidance of students for the conferment of PhD degrees as part of the PhD programme of the Institute, as well as the active Visiting Students Programme under which a number of students from all over the country visit the Institute for stays ranging from a few weeks to several months and participate in the many research activities of the Institute. Communications of the ongoing research and also a sharing of knowledge of current research– in professional talks given by members of the Institute in conferences and in external institutions as well as Journal Review talks at the Institute– is another aspect of our knowledge diffusion.

Visiting Student Programme introduced in the year 2007 is aimed at offering research experience to highly motivated students who are pursuing their under-graduate or post graduate studies. During the period of the visit, the student works closely with at least one staff member of the Institute on a suitable project. During the year 68 students from different parts of the country participated in the research of the Institute as part of this programme. The duration of the working visits was mostly between 3 and 6 months; some visits were for a year.

The Library established a close liaison with appropriate libraries of other institutes in the country through FORSA and DST multi-institutional consortia. In addition, the Library has access to IEEE/ IEE electronic library through INDEST consortium and to 14 publishers through CSIR-DST E-journal consortium.

Astronomy & Astrophysics and related signal processing, imaging, and instrumentation development

The Raman Research Institute is now a full partner in an international collaboration – the Muchison Wide-field Array – to build a large low radio frequency telescope array in a remote Western Australian radio-quiet location, which is a pathfinder to the International Square Kilometer Array project. MWA is collaboration between US and Australian partners and the Raman Research Institute. The participation includes contributing to engineering in the form of digital systems and software– which challenge and stretch our in-house capabilities in appropriate directions– and involvement in specific science goals by sharing the development of innovative observing techniques, analysis methods, detection algorithms and parameter extraction tools. RRI members worked as part of international teams in campaign mode installing, testing and commissioning telescope systems at the remote site in Western Australia. There are now 32 antenna tiles on the ground at the site, with which prototype digital receivers built at RRI were successfully tested in observations of astronomical objects.

Fig: The MWA at the SKA site in Western Australia.

Fig.: Digital receivers for the MWA built in RRI electronics laboratory.

A digital receiver for this array has been developed at the Institute. It is designed to operate between 80 and 300 MHz, and will be capable of high dynamic range imaging. The digital receiver was designed for MWA in collaboration with Scientists and Engineers at ANU and was built at RRI. The digital receiver digitizes the RF signals using a set of dual 8-bit ADCs operating at 655.36 MHz. The first Nyquist zone is subdivided to 256 channels using a polyphase filter bank; the bandwidth of each filter is 1.28 MHz. Data from a selected set of 24 filter bank outputs, which corresponds to a total bandwidth of 30.72 MHz, is sent to the correlator through three optical fiber links. The hardware work at RRI involved the design and development of Virtex 5 FPGA based data aggregation and formatting board (AGFO board), backplane, duplication of ADC boards (ADFB) provided by CSIRO and building a clock and synchronization signal distribution system. Firmware was designed and developed for interfacing the ADC to FPGA, implementing the features needed for observing with the digital receiver, transporting data from receiver to correlator through optical fiber and recording data using a VSIB based data acquisition system (DAS).

After the development and testing of a receiver at RAL, four prototype receivers were made. These receivers were successfully used for test observations at MWA site (Boolardy, WA) by recording data with the VSIB based DAS and software correlation. Currently the digital receiver and the hardware correlator are being interfaced through optical fiber link. A set of firmware was also developed for testing and validating the receivers during their mass production.

The year saw the fructification of a novel project developing a wide-band antenna and a multi-band receiver for simultaneous observations of celestial phenomena over a range of radio wavelengths when mounted at the focus of a large dish antenna. The project was specifically designed to be mounted at the focus of the US Green Bank telescope, which is the largest steerable dish antenna in the world. RRI members, including PhD students, have been granted competitive telescope time to use the instrumentation for specific investigations before it would be made available to the international community as a new facility.

Fig: RRI receiver on the Green Bank telescope in West Virginia, US.

Fig: View of the receiver systems built in the RRI electronics laboratory

This GBT-RRI Multi Band Receiver system was designed, developed and successfully tested. This is a self-contained receiver system, consisting of a dual-polarization feed covering a wide-span in its spectral response (100-1500 MHz), to be used at the prime focus of the Green Bank telescope. The system was motivated by the need for simultaneous high time and spectral resolution studies of pulsar emission at

single-pulse level, opening possibility of tomography study of pulsar emission cone. The system caters to simultaneous sampling of dual polarization voltage signals in the 10 bands, tunable in pre-selected (relatively) RFI-free windows, within its wide-spectral range. Each of the 10 pipelines contains an RF/IF section and a digital back-end for recording directly the raw voltage time-sequence in two polarization channels. The sampled data is transferred to 10 DAS computers, each catering to one band, connected through Gigabit Ethernet to a master computer which runs the monitoring and control (M&C) software. The M&C software controls the RF & IF attenuators, LO frequency, and data acquisition. The complete system was first tested at GMRT field station in Oct 2008 and subsequently thoroughly tested in GBD field station till April 2009, before installing it at Green Bank, WV, USA, and used with the GBT.

The X-ray astronomy laboratory is now actively building and testing critical components and evaluating novel design configurations for the polarimeter, and designing and testing electronics and logic circuits that are essential for the detectors. The development of a Thomson polarimeter using rectangular detector configuration has been completed. The development includes proportional counter detectors, associated front-end electronics, event processing logic, data acquisition system, and test and calibration system. The unit has been successfully tested in the energy band of 9-23 keV and a modulation factor of ~35% has been obtained. The mechanical fabrication of detectors for a cylindrical polarimeter configuration has been completed. An FPGA based pulse processing electronics based on charge division technique is under development. Proposals have been submitted to ISRO for mission approval.

The Institute continued its development of low-cost 12-15 metre class parabolic dish antennae. Noteworthy developmental effort during the year was the evolution in the preferred design to a Bent-Spoke Dish.

Members of the Astronomy & Astrophysics group are currently engaged in research into the understanding of events in the evolving universe and a variety of phenomena associated with cosmic bodies. Research on reionization and structure formation examined and pointed out the potential of observations of cosmological redshifted 21-cm line radiation both as probes of cosmological parameters and primordial magnetic fields. Studies of active galaxies examined the origins for their radio structures, and the consequences of the cessation of activity. Extragalactic research included galaxy interactions, stellar dynamics in nuclear regions of galaxies, the formation of cluster halos and galactic outflows. The report includes work done at RRI on foundational problems in the astrophysics of accretion disks and dynamo theory. The X-ray flux variations in a number of Galactic X-ray binaries have been used to expand our knowledge of these enigmatic astrophysical objects.

The telescopes and receivers developed and built in the Radio Astronomy Laboratory provide vital observational clues for this research. However, windows covered by the Institute's facilities cover only a part of the electromagnetic spectrum. Additionally, a holistic investigation of space phenomena often requires observing capabilities not available in India. Therefore the astronomers of the Institute propose and successfully win the use of valuable observing time on facilities throughout the world.

Light and Matter Physics

Research work at the Institute continues to include classical optics, which was one of the key areas of research in the days of the Founder. Recent work includes original contributions to eigenvalue toggling of optical activity, and insightful use of the van de Hulst theorem for reflection of polarized light. Experimental work includes investigations of light transmission in mixtures of magnetite nano- and micro-sized spheres, and light emission from carbon Nanotubes.

The last several years of committed effort has brought the experimental capability to the stage where confidence has been established in the setting up of laser systems, vacuum chambers, and laser cooling and trapping of atoms in magneto-optic traps. Cold clouds of Rubidium are now routinely made in the vacuum traps. Megnoto-optic traps with miniature coils have also been successfully constructed and operationalized, enabling multiple traps within the same chamber for controlled quantum interactions. Preliminary experiments on Electro-magnetically induced transparency within hyperfine transitions of cold atoms have been successful.

Research in non-linear optics included degenerate four-wave mixing to characterize samples and identify candidates for photonic device applications, z-scan experiments using white light super-continuum source, and the recording and analysis of X-ray emission from laser-induced plasma in a planar water jet.

In experimental quantum optics experiments include laboratory measurement of the deflection of light owing to gravity and an experiment to observe quantum walks by ultra-cold atoms in a double optical lattice.

Soft Condensed Matter

The Institute has made outstanding contributions to the development of the field of liquid crystals for over three and a half decades. Liquid crystals are a thermodynamic stable phase of matter that has anisotropy of properties without the 3-dimensional order of crystal lattices. Nematic liquid crystal molecules are rod-like and tend to point in the same direction but without positional order; smectic liquid crystal molecules align themselves in layers that can flow past each other; in discotic liquid crystals disc-like molecules are stacked in parallel columns. There are many more complex forms of molecular ordering known with interesting and subtle properties; research in this field at the Institute is unique in that it enjoys the interactions between chemists, electrochemists, condensed matter physicists, theoretical physicists and members with statistical physics expertise.

Liquid crystalline substances have interesting optical properties, and external perturbations can cause significant changes in their macroscopic properties; the theoretical and experimental research at the Institute is towards understanding these unique effects and synthesizing new liquid crystalline materials. Novel mesogens with bent-core molecules continue to be synthesised in the liquid crystal laboratory, and uncommon and sometimes completely new phase transitions have been observed. The phase behaviour of functionalized carbon nanotubes, when dispersed in discotic monomers and polymers, were studied. Synthesis of rod-disc oligomers, ionic liquid crystalline polymers, electron-deficient discotic liquid crystals, discotic liquid crystalline symmetric donor-acceptor-donor triads and experimental studies of their mesophase behavior represent further examples of current research. Other experimental research in liquid crystalline materials included studies of non-equilibrium fluctuation theorems.

A niche area of research at the Raman Institute is in the development of techniques for driving the matrix displays: using sophisticated signal processing algorithms and methods to reduce power consumption in the display drivers. International patents have been filed to protect intellectual property rights in this area.

Research of the soft condensed matter group, which was earlier focussed on liquid crystals, has now expanded into examining physical effects, including electrical conductivity, arising from the dispersion of nanoparticles and enzymes into the bulk of liquid crystalline phases, and properties of films and monolayers formed by mesogens and complexes containing mesogens. The soft matter group has research interest in instability pattern formation in liquid crystals as well as in interfaces between Newtonian and aging non-Newtonian fluids. Experimental studies included micro-viscosity measurements in aging clay suspensions,

and examination of the structure, dynamics and mechanical properties of copolymer solutions in which ionic surfactants have been added. The phase behaviour of amphiphilic systems at interfaces and in the form of membranes has been studied.

Consistent with the vision of the group to include a flavour or 'nano' in the soft matter research, several works reported herein involve physical effects, including magnetic susceptibility and optical limiting properties, of nanocomposites synthesized in the Institute and nanoparticle and nanosphere dispersions in liquid crystals. Development of innovative methods for preparation of thiol stabilized gold nanoparticles, mesoporous gold films and polyelectrolytes.

Experimental biological physics is an area into which the soft matter research at the Institute has taken a step. Initial experimental efforts in this research area are groundwork towards dynamical studies of cell shape and mechanical studies of Axons.

Soft matter research has in some cases used specialized investigative techniques, for example, oscillatory rheology studies and magnetic susceptibility studies, for appropriate problems. All of the investigations into the fascinating behaviours, quantitative measurements of the properties and the response to various control parameters and the experimental elucidation of the molecular ordering in different circumstances, require sophisticated and modern equipment. The group has instruments like an atomic force microscope, scanning tunnelling microscope, polarization and confocal microscopes and apparatus for X-ray diffraction. Upgrades to existing equipment and measuring devices as well as the acquisition of new facilities that open new windows to the studies are an ongoing activity.

Theoretical Physics

Theoretical physics research in the Institute is in the areas of condensed matter physics, statistical physics, physics in biology and gravitation, which includes classical and quantum gravity and gravitational radiation. The research outcomes include analyses of fundamental questions in optics, quantum mechanics and general physics.

Recent theoretical work considered a variety of issues, including questions ranging from the dynamics of a charged particle moving on the surface of a sphere in the presence of an external uniform magnetic field, understanding quantum measure theory, to geometric and topological contributions associated with the phase in neutrino oscillation formulae, which may be akin to the Pancharatnam topological phase. In non-equilibrium statistical mechanics, research continues in the formalisms associated with heat current in open systems, the probability distribution of heat flow and the heat conduction in disordered harmonic crystals, and electron transport in mesoscopic systems. Studies of the evolution of flexible polymer chain as it tumbles end to end in a shear flow was a topic of recent research.

In biological physics research, recent work continues on statistical mechanical study of stiff polymers motivated by buckling phenomena in cellular cytoskeletons.

In general relativity, research has been on precise calculations of the gravitational wave-forms expected from in-spiralling binaries. This problem is of contemporary significance because of the coming on-line of gravitational wave detectors, which need an accurate 'template' with which the data may be cross correlated in order to detect cosmic signals. During the year, research has moved into examining signal detection with future space based gravity-wave detectors, pointing out that LISA observation of SMBH coalescence events could potentially constrain the dark energy equation of state. Additionally, derivations of analytic

solutions of orbits in Kerr space-time and numerical computations of the gravitational waves induced by particles on eccentric inclined orbits around Kerr black holes are reported herein.

Quantum gravity research at the Institute has continued in the Causal Set approach and Loop quantum gravity. Further development of the analogy pointed out by members between the cosmological constant of the Universe and the surface tension of fluid membranes constitute recent research that shows the generality of the analogy beyond the Causal Set approach.

SREE CHITRA TIRUNAL INSTITUTE FOR MEDICAL SCIENCES AND TECHNOLOGY

The Government of India had declared the Sree Chitra Tirunal Institute for Medical Sciences and Technology, Thiruvananthapuram as an institute of National Importance under DST by an Act of Parliament in 1980. The mandate of the institute is to develop appropriate technologies to meet the healthcare needs of the country and initiate training and research programmes integrating biomedical technology and health sciences, while demonstrating high standards of patient care in medical specialties. The Institute therefore has a Biomedical Technology (BMT) Wing for the R&D activities, a tertiary care Hospital for cardiovascular thoracic and neurological diseases and the Achutha Menon Centre for Health Science Studies for research and training in public health.

The objectives of the Institute are:

- Promotion of biomedical engineering and technology
- Demonstration of high standards of patient care and
- Development of post-graduate training programs of the highest quality in advanced medical specialties and biomedical engineering and technology

A summary of the important achievements during the year are as follows:

Biomedical Technology Development:

Technology Transfer agreement of porous Hydroxyapatite and Bioactive HABG composite for Dental Applications to IFGL Refractories Limited, Kolkata was signed on 13 January 2010. IFGL's Bioceramic division is engaged in production and marketing of bioceramic products like hydroxyapatite orbital implants, alumina based hip joint femoral head, bone regenerative granules and blocks, etc. An agreement was made with Tata Memorial Centre, Mumbai with regard to the collaborative work of the nanoparticle technology for chromatin adsorption. National Accreditation Board for Testing and Calibration laboratories (NABL) has granted Accreditation to the Calibration Cell of the Institute in the mechanical and thermal calibration streams. This enables the Institute to provide accredited calibration certificates for meeting the requirements of its internal quality management system as well as its external customers. The scope of accreditation includes temperature measurement instruments, hot air chambers, incubators, water baths, volume measurement instruments and electronic balances. The accreditation is valid for a period of three years. COFRAC surveillance assessment was conducted on 13 July 2009. There were no Non-Conformities in the surveillance assessment conducted by COFRAC assessor.

Patents Applications filed during the year

(i) 'A process for the development of visible light cure dental restorative resin composite containing a new photo initiator with improved properties'

(ii) 'A process for the simultaneous conjugation of heparin and polyethylene glycol on to the surface of intraocular lens to improve biocompatibility'.

(iii) 'Visible light induced insitu gelling biopolymer composite as a wound dressing'
(iv) 'A process for the modification of magnetic nanoparticles using curcumin conjugates as multi drug carrying vehicles for targeted drug delivery applications'.
(v) 'A method for preparing curcuminoids with enhanced water solubility for pharmaceutical and other medical applications'.
(vi) "Method for in-vivo binding of chromatin fragments"

New Projects

- 'Development of a dura substitute by electrospinning of ?-caprolactone-co-lactide polymers' was sanctioned by Kerala State Council for Science, Technology and Environment, Trivandrum
- 'Development of neurons from circulating progenitors" by DST
- "Dermal wound healing" sanctioned by CSIR
- "Pulsed laser Ablation of Bioactive Ceramic Composite on Titanium Bone Implants"
- 'Development of magnetic nano particles for MRI contrast applications'-
- "Dispensable and biodegradable polymeric bone cement for minimally invasive treatment of bone diseases - product validation" project sanctioned by DST
- 'Production of drug-loaded nanoporous bioceramic spheres for orthopaedic applications'
- "Development of bioactive bone cement based on organically modified ceramic resin"

Hospital Services

The hospital continued to provide tertiary care to an increasing number of patients. As a result of reorganisation, up-gradation and commissioning of state-of-the-art equipments, the quality, efficiency and throughput of the hospital increase significantly. Several new diagnostic and therapeutic programmes were started. In its efforts to extend affordable care to the socio-economically disadvantaged sections of the public, the institute provides services in a reduced user charges. This is despite the financial constraints due to steady decline in non-plan grants. The Telehealth and Medical Education Project did more than 140 tele-consultations and 3 Continuing Medical Education programmes.

Some of the important hospital statistics are:

(a) Sanctioned Bed strength: 239,
(b) Bed Occupancy rate: 86.03%,
(c) Average Length of stay: 7 Days,
(d) Bed Turnover Rate : 37 patients,
(e) New Registration: 13888,
(f) Repeat cases: 94827,
(g) Admissions: 8463,
(h) Percentage of mortality: 2.06,
    (i) Cardiac surgeries: 1685,
    (ii) Neuro surgeries: 1216,
    (iii) Investigations: 822822.

Epilepsy

The Epilepsy program of the Institute caters to medically refractory epilepsy patients from all over India and is unique in that it is the best of its kind in the country and caters to a wide range of difficult-to-

treat cases in par with Western standards. This is possible with all its modern advanced technological investigative tools like high resolution MRI with special sequences, functional MRI (which identifies eloquent areas and its functions like motor function and language), etc. During the year, 83 surgeries were done.

Movement Disorder

In the Movement Disorder Section, 7 Deep Brain Stimulation Surgery: 6 Neurostimulator replacement: 2 Pallidotomy: 134 Botulinum Toxin Injection: 1364 Movement disorder specialty clinic attendance: and 70 Pre & Post operative follow-up were done in the year.

Academic Programmes

The institute currently offers 25 academic (diploma, postgraduate, doctoral and post doctoral) courses in medical sciences, biomedical engineering and technology, basic sciences and public health. All academic programmes continue to attract students in significant numbers from all over India and for the MPH course, from other countries as well.

During the year, 126 Projects were undertaken, 10 Patents granted, 9 Patents filed and 146 papers published in Journals.

ACHUTHA MENON CENTRE FOR HEALTH SCIENCE STUDIES

Achutha Menon Centre for Health Science Studies (AMCHSS) has proved to be both a milestone and a trendsetter in public health training and research in the country. The centre in addition to offering DPH, MPH and PhD programmes, conducted number of short-term courses in maternal health, ethical and gender dimensions in healthcare for national and international students. It also provides consultation to NGOs, governments and international bodies on a wide range of public health, gender and ethical issues.

Conferences/ Workshops Organised

Indo-Dutch Workshop

As a follow up of the MoU signed between the Governments of Netherlands and India in March 2008 and the signing of a programme of cooperation in March 2009, DST entrusted the Institute to

organize twin Indo-Dutch Workshops on 1) Medical Devices for Affordable Health and 2) Life Sciences & Health during 21-23 January 2010 at Trivandrum. The workshops were supported by The Netherlands Organization for Scientific Research (NWO), The Netherlands Organization for Health Research and Management (ZonMw) and the Senter Novem, Dutch Ministry of Economic Affairs of Netherlands. Seventeen invited technical experts and 7 organizers from the Dutch side and 33 experts and 4 organizers from the Indian side participated in the two workshops held parallely. The workshops contained a mixture of clinicians, engineers, scientists and technologists who interacted with each other on a common platform.

Indo-US Advanced Clinical Engineering Workshop - India (ACEW-India, 2009)

The Clinical Engineering Workshop was conducted at Trivandrum from 5-10 October 2009.The main objective of the workshop was to inform stakeholders of the health care system about modern clinical engineering professional practices and healthcare technology management strategies. It was envisaged that this workshop would also make a significant contribution to joint efforts of SCTIMST, IIT Madras and CMC Vellore in starting M. Tech. programme in Clinical Engineering, the first of its kind in India. The workshop covered a wide range of technology management and equipment maintenance issues in healthcare domain such as strategic planning, equipment acquisition, maintenance planning, user training, risk management, financial planning and management, replacement planning as well as device regulation, telemedicine, human factors, electromagnetic interference and telemetry.

TECHNOLOGY, INFORMATION, FORECASTING AND ASSESSMENT COUNCIL

The Technology, Information, Forecasting and Assessment Council (TIFAC), an autonomous society set up under the Department of Science and Technology in 1988, is mandated to assess the state-of-the-art technology and set directions for future technological developments in India in important socio-economic sectors. Significant achievements during the year included continuation of the efforts to strengthen and expand TIFAC activities with regard to technology assessment and foresight, prioritize and design technology interventions, and learn from projects and interventions undertaken. Achievements in some of the significant activities are highlighted as follows:

Foresight and assessment activities

TIFAC embarked on preparing a Detailed Project Report (DPR) for the National Innovation Project, an initiative to address some of the system constraints and leverage innovations for rapid and inclusive growth. The DPR covering three different components of strengthening Nation Innovation Management, Strengthening the technology commercialization and supporting innovation by SMEs, was completed and submitted to World Bank through DST.

A series of sector-specific studies have been taken up to bring out the dynamics, the constraints and the enablers, and the impact of Foreign Direct Investment (FDI) in the Indian R&D sector.

Innovation support

The experience of working with individual innovators had prompted TIFAC to design and launch the Technology Refinement and Marketing Programme. This programme is expected to reduce the distance of innovation chain. To start with, six agencies have been selected as Technology Commercialization and Facilitation Agencies (TCFAs) initially for a period of one-year.

Agriculture

Project designs addressing crop diversification, organic cultivation, primary processing and systems and effective training programme to empower farmers have impacted the overall increase in productivity and increase in farmers income levels in the agricultural sector.

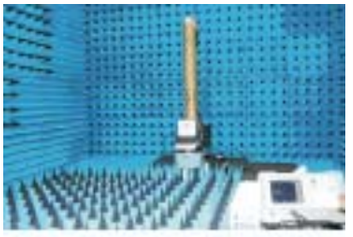
CAR

The Collaborative Automotive R&D programme continued supporting pre-competitive projects, directed basic research and prototype development projects through its restructured arrangement with four specific panels in the field on automotive electronics, materials and manufacturing, IC engine and drive-train and electric and hybrid-electric propulsion.

Mission REACH

Six new TIFAC Centres of Relevance and Excellence (COREs) were set up during the period, increasing the number of TIFAC COREs to 37.

Bioproducts and Bioprocesses



The program has selectively supported projects aimed at developing high value pharmaceuticals ingredients, neutraceuticals and phyto-chemicals. Centre for Biofuels was set up at the National Institute for Interdisciplinary Science and Technology (NIIST), Tiruvananthapuram. This centre would undertake cutting-edge research activities in bio-refinery related technologies.

VIGYAN PRASAR

Vigyan Prasar was set up by the DST as an autonomous organization for taking up large-scale science popularization tasks in the country. Major scientific achievements and highlights during the year are as follows:

S&T Communication through Television

VP telecast serials on every Sunday morning on DD National Channel.A 26-part video serial on the theme of Astronomy, titled 'Taron Ki Sair' began in September 2009. Dubbing of 13-episode TV serial "Dekh Khel Ke", 14-episodes of "Jeete Raho" and 12-episodes of "Our Celestial Neighbours" in 11 Indian languages has been completed and telecast through the regional Kendras of Doordarshan. Production of a 3 part serial on "Eclipses" was produced on the occasion of Total Solar Eclipse- 2009.

S&T Communication through Radio

VP in association with All India Radio produced a 52-part radio serial on Astronomy titled "Sitaro Se Aage", as part of the International Year of Astronomy- 2009. The broadcast of the serial began in April 2009 in 19 languages from 117 radio station of AIR. Several voluntary agencies were associated in preparation of the language versions. VP's programmes were broadcast twice a week from several Gyan Vani Stations

S&T communication through Edusat

VP in association with DECU, ISRO has established a network of 50 satellite interactive terminals using the Edusat at different places in the country. It is being used for S&T communication/ popularization which could also serve as an emergency communication network during and after natural disasters. 18 popular science lectures were organized on Edusat Network from December 2009 to March 2010. A quiz on Life Science was held on the occasion of 100 birth anniversary of Sir J.C Bose. A workshop on "Science Writing through Distance Education" was organized in February 2010 for the SIT participants. 3 training programmes on Weather kit were conducted while 4 group discussions on 'Women's Health and Nutrition' were organized. A seminar on "Education & Health for Rural & Tribal Women" was held on 8 March 2010. Science films produced by Vigyan Prasar were also multicast during the period. Around 5000 people were trained through these programmes.

A special series of multicast sessions on Solar Eclipse in Marathi, Bengali, English, Tamil and Hindi were organized to meet the demand from the users.

Vigyan Prasar NETwork of Science Clubs (VIPNET)

VP organized a series of ten sensitization-cum-orientation programmes in different places in the country during the period for establishment of science clubs and initiated science popularization activities in different parts of the country.

"VIPNET News", monthly newsletter for VIPNET Science Clubs was regularly brought and total number of VIPNET Clubs is 10,198 now. As a part of Total Solar Eclipse Campaign and International Year of Astronomy-2009, VP has developed a kit comprising of solar filter for dissemination. The kit and solar filter were sent to more than 8000 VIPNET Clubs.

Publication Programme

Under the publication programme, Vigyan Prasar brought out 12 titles under different series both in English, Hindi and other Indian languages. Six reprints were brought out in 2009-2010. Ten titles were brought out jointly by VP and Sasta Sahitya Mandal, Delhi.

Vigyan Prasar has been bringing out a monthly bilingual (English & Hindi) newsletter-cum-popular Science Magazine "Dream 2047". The newsletter reaches scientists, teachers, students, schools, institutions and general public. The present circulation of the newsletter is over 52,000.

Vigyan PRasar Information System (VIPRIS)

VP Website: (www.vigyanprasar.gov.in) has been updated with additional features.

Digital Library: Digital Library created by Vigyan Prasar was listed in 'Scholarly Literature and Digital Library Initiatives' brought out by UNESCO. So far over one lakh seventy thousand people visited the site and there are over seven thousand registered users. Streaming Audio and Video: every fortnight three science videos were uploaded for streaming video.

Discussion Forum of VP website is platform where anyone can ask scientific questions or answer fellow participants' queries. Experiments and activities related to physics developed in collaboration with IIT Kanpur are available in VP website. Hindi website is being updated regularly. VP also conducted two live chat session on VP's website

VP brought out a CD on "Computer for Housewives". The CD was released during the National Science Day. The news clipping service "VIPRIS Clipset" is being continued.

Scientific Experiments using a PC

VP is engaged in the development of new training modules/ methodologies/ equipment/ devices for S&T communication. VP has conducted a number of demonstrations and workshops to explain how experiments on measuring and controlling parameters like temperature, intensity of light and sound, humidity etc. could be taken up to illustrate use of computer in a variety of processes. The kit is available commercially.

Innovative Experiments in Physics

Vigyan Prasar and Department of Physics, Indian Institute of Technology (IIT), Kanpur, have jointly undertaken a project entitled "Development of Innovative Physics Experiments and Training of Teachers for Experiment Based Teaching". A number of workshops were conducted to train teachers in innovative physics activities/experiments. About 2500 teachers are trained in using these innovative activities in the classroom.

Ham Radio

VP organized five lecture and demonstration programmes in Uttarakhand, Haryana, Jaipur, New Delhi, and Uttar Pradesh during the year. A session on "Role of Ham Radio in Disaster Management" was conducted at National Institute of Disaster Management (NIDM, Indian Institute of Public Administration) in December 2009 on the occasion of a 'Training Programme on Basics of Disaster Management for Civil Defense Officers'. 14 Civil Defense Officers from different parts of the country participated in the programme.

VP participated in a DST sponsored programme Scientist and Administrators' Interface Programme at Centre for Disaster Management, Lal Bahadur Shastri National Academy of Administration, Mussoorie, in December 2009. During the panel discussion and 'Experience Sharing Session', a lecture on Role of Ham Radio

Automatic Packet Reporting System in Disaster Management' was deliberated along with practical demonstrations.

A glimpse of Ham radio demonstration

A reconnaissance was conducted by going to Dhanaulti to select a suitable site for the proposed Vigyan Prasar VHF ham repeater station in Uttarakhand.

Astronomy Popularization Activities

Following programmes have conducted by the Vigyan Prasar in popularizing astronomy and space sciences in the country.

Campaign in NCR for Total Solar Eclipse: 22 July 2009

Vigyan Prasar organised a national campaign on Total Solar eclipse (TSE)-2009 in National Capital Region. There were about 150 government and private schools participated in the campaign. In total around nearly 200 teachers and more than 500 students were trained in five campaign programmes.

Master Resource Persons Training Programme

On occasion of International Year of Astronomy 2009, VP in collaboration with NCSTC had conducted 4 Master Resource Persons' Training programmes in four zones at Shillong, Chennai, Amritsar and Mumbai respectively. The programmes were in the month of May and June 2009.

Vigyan Prasar and Indian Air Force: A joint Programme of observing Total Solar Eclipse: 22 July 2009 : Vigyan Prasar and Indian Air Force jointly coordinated and executed a scientific campaign during the total solar eclipse on 22 July 2009 to record the eclipse. One transport aircraft AN-32 and two fighter aircraft Mirage 2000 participated in two different missions. The Indian Institute of Astrophysics, Bangalore and Udaipur Solar Observatory, Udaipur were joined for the scientific expedition while Doordarshan was collaborator to capture the event of totality.

A view inside the aircraft during the TSE-2009

National Campaign in the belt of totality for Total Solar Eclipse

Vigyan Prasar in collaboration with State level agencies undertook a country-wide campaign in the belt of totality of Total Solar Eclipse on 22 July 2009 to create awareness about the event among VIPNET clubs, students, teachers and general public. The two day programme was organized at four different locations viz Indore, Bhopal, Patna and Dibrugarh.

Activity Kits

Three demonstration programmes on activity kits developed by Vigyan Prasar were organized at Sonipat, Bhopal, Gwalior, Jodhpur during 2009- 2010. Workshops on 'Fun with Electronic', 'Electronics' and 'Weather kit' were organized for different SITs on Edusat Network during the year. VP brought out a modified version of Astronomy kit and more activities were incorporated related to Total Solar Eclipse 2009 and Annular Solar Eclipse 2010. Workshop on Astronomy conducted for the Madhya Pradesh teachers during 19 - 22 July 2009 at Bhopal in collaboration with M.P Science Centre (Gwalior). A quiz programme on science was organized during Perfect Health Mela - 2009.

Training and Dissemination

A workshop was conducted on "Understanding Planet Earth" in Bangalore during April 2009. The programme was hosted by National College, Jayanagar and arranged by Karnataka Rajya Vijnana Parishat with the support of VP.

As a part of the International Year of Astronomy & Total Solar Eclipse Campaign, Vigyan Prasar organized jointly with NCSTC, 4 Regional Level Training Programme to train master resource persons through out the country. About 200 participants, representing State Councils and different Scientific Institutions/ Agencies, participated.

A national camp on observation of Annular Solar Eclipse was organized during 14-16 January 2010 at Kanyakumari. Around 600 children along with 200 coordinators/teachers from 26 States and UTs had participated.

Book Fairs / Science Fairs / Science Meets / Seminars

VP participated in Delhi Book Fair held in Delhi and World Book at Delhi and National Book Week organized by National Book Trust, during the period in different parts of the country. VP participated in a Perfect Health Mela in Delhi. Vigyan Prasar participated in the Gwalior Mela. VP participated in 2nd Vigyan Sammelan at Indore during 27 November to 3 December, 2009 organized by Madhya Pradesh Council of Science and Technology, Bhopal. VP participated in an international conference on Hands on Activities at Science City, Ahmedabad during 27- 31 October 2009. In this conference

International Year of the Astronomy -2009

As part of the International Year of Astronomy (IYA 2009) VP chalked out various programmes for different target groups including a radio serial, a television Serial, publications, activity kit, demonstrations, training, workshops, national campaign on Total Solar eclipse (TSE) and wareness cum popular lecture programme.

WADIA INSTITUTE OF HIMALAYAN GEOLOGY

Wadia Institute of Himalayan Geology, Dehradun, has been continuously striving to unravel the geological truth related to building of majestic Himalaya through its present scientific activities centered around five Mission Mode projects.

Structural and AMS studies in the Garhwal synform of Lesser Himalaya showed that normal faulting acted as reactivated thrusts between different grades of metamorphism that brought them up as pop-up klippen structures. In the light of geochemical evidence, the granitoid rock of eastern Kumaun suggest for their derivation from a Paleoproterozoic mafic/intermediate lower-crust reservoir involving arc magma underplating. From the field and geochemical studies of eastern Shyok Tectonic Zone, Ladakh it is envisaged that the orthogneiss, and in-situ remelting of earlier rocks during Miocene times, seems to have played a fundamental role in the crustal growth and evolution of the region. Two phases of evolution have been traced in Manipur Ophiolitic Complex, Indo-Myanmar Orogenic Belt, one involving low degree partial melting of Mid Oceanic Ridge Basalts and the second phase of sub-aqueous nature of volcanism. Chromium spinels of Ophiolitic complex also show enriched concentrations of platinum group of minerals (Ir, Os, Ru), that are comparable with the ophiolitic chromites worldwide. The evolution history of the Ultra-high pressure rock is corroborated further through the studies of various phases of fluids present in coesite bearing rocks. Minamiite, a Ca-bearing hydrous sulphate mineral, is reported for the first time in India from the Deccan Volcanic Province at Matanumadh (Kachchh, Gujarat). Its presence can serve as a potential Earth analogue for the Mars and the Martian conditions. Geochemical investigations of stream sediments in Pinjaur Dun, NW Himalaya indicated enhancement of metal concentration due to leaching of metals from garbage and industrial sewage.

Continuous radon monitoring along with meteorological/geohydrological observations in a bore hole at the Garhwal Himalaya showed two unique anomalies during June and July 2007, which were considered precursory to the M4.9 Kharsali earthquake of 23 July 2007. The studies emphasize that anomalies of radon can be used as tool for precursor studies of earthquakes. Scientists of the Institute have developed a technique based on the polarization eclipse parameter to distinguish earthquake precursor's signals from natural ion solar ionospheric interaction. Lichen studies formed on loops of moraines of Chorabari and Dokrani-Bamak glaciers, have shown the retreat of glaciers started about 258 and 314 years respectively. A 4 m thick unit of high-silica rhyolitic tuff breccia crops out between the Sirban Limestone and the base of

the Subathu Formation in Kalakot area of Rajauri district of J&K. The rock can provide a stratigraphic evidence of the earliest collision between the Indian and the Asian plates and form an important time-synchronous stratigraphic marker horizon in the foreland stratigraphy. The additional palaeontological data from the lower Paleogene successions in the Zanskar Tethyan Zone (Ladakh) has also helped to establish a revised and more precise zonal scheme based mainly on larger foraminifera.

Under the on-going research programs pursued during the year, the Institute has published more than 65 papers till date with 48 papers in SCI journals. It produced four Ph.D. theses, and two theses were submitted for award from the scholars pursuing research. As a continuing drive to up-grade analytical laboratories, a new XRF machine is added to existing facilities. As an academic pursuit, the Institute organized a Seminar on "Seismogenesis to PREDiction of earthquakes: Himalaya and Indian Sheild Perspective - (SPRED-2009)" on 22-24 October 2009. The Institute jointly with NGRI and ONGC has hosted the 'Forty Sixth Annual Convention of Indian Geophysical Union' and a meeting on "Evolution of Himalayan Foreland Basin and Emerging Exploration" on 5-7 October 2009. The Institute has also hosted an application training of Electron Probe Micro Analyser (EPMA) organized by M/s Gannon and Dunkerly, Mumbai from 9-13 November 2009. Mr. Michel Outrequin, the application specialist from CAMECA, France imparted the training to EPMA users. On 18 September 2009 a Hindi workshop was organized as part of Hindi Pakhwara celebrations of the Institute.

The Centre for Glaciology was inaugurated in the Institute by Shri Prithviraj Chavan, Hon'ble Union Minister of S&T on 4 July 2009. The Multi Parametric Geophysical Observatory (MPGO) established by the Institute for earthquake precursory research at Ghuttu was formally inaugurated on 28 May 2009. The Institute also had the privilege of a visit by Shri Montek Singh Ahluwalia, Deputy Chairman, Planning Commission and Shri Jairam Ramesh, Hon'ble Minister for Environment & Forest, Government of India.

New XRF machine added to existing facilities of the Institute

S.N. BOSE NATIONAL CENTRE FOR BASIC SCIENCES

Mandate and Objectives

The S. N. Bose National Centre for Basic Sciences, Kolkata was established in June 1986 as a registered society functioning under the umbrella of DST. Its objectives are :

- to foster , encourage and promote the growth of advanced studies in selected branches of basic sciences;
- to conduct original research in theoretical and mathematical sciences and other basic sciences in frontier areas, including challenging theoretical studies for future applications;
- to provide a forum for personal contacts and intellectual interaction among scientists within the country and also between them and scientists abroad;
- to train young scientists for research in basic sciences.

Major theme for the Eleventh Five Year Plan

- Focus on areas of research where we can make an impact internationally and also there is a national need.
- Facility development (both technical and physical) that is commesnurate with the research objectives.
- Establish the centre as a major hub of advanced schools and colloquia as per its original objectives.
- Effective advanced manpower training in the areas of basic sciences.
- Performance enhancement through positive intervention.

  In the 11th plan period the major research areas are as follows:
- Physics of nanomaterials including application-specific materials development.
- Advanced computational materials science including soft condensed matter.
- Interface of biology and condensed matter physics including fluctuation and stability of biomolecules, DNA-protein interactions and biomolecular recognition in physiological conditions , biology of extreme conditions , application of ultra fast spectroscopy in biomolecules and quantum effects in fast molecular and non-adiabatic process.
- Theoretical work on black holes and its cosmological consequences. And Astrochemistry

Significant Scientific & Technical Achievements

Research

a) Femtosecond Laser system for time-resolved magneto-optical Kerr microscopy of Nano structure materials.

b) Two cluster computer based high performance computing facility is functional.

Major New Physical Infrastructure

The number of students in the Centre has increased manifolds. Work on construction of new Integrated Hostel Block has started in December 2009. Civil work for Clean Room is nearly completed.

Teaching

a) No. of Post B.Sc Integrated Ph.D students intake : 09

b) No. of Post M.Sc Ph.D Programme students intake : 24

c) No. of Ph.Ds submitted/ awarded : 14

Department of Theoretical Sciences

The Department had activities in several areas resulting in 43 publications. Studies on gravity and black hole thermodynamics including their connection with non-commutative geometry were done. Renormalisation group ideas were invoked to study differential equations and non linear phenomena. Connections of SU (2) group to monopoles and flux strings hile that of SU(3) to Schwinger bosons were revealed. Weighted trade network, stochastic external model, topological excitations and the Kohn anomaly were some other topics. In mathematical physics, nonholonomic deformation, Sundman transformation and various aspects of lagrangian formalision were investigated.

Department of Material Sciences

The department is working on various theoretical and experimental aspects of condensed matter. In the theoretical side various aspects of spin orbit interactions in some materials; effects of disorder in superconductivity, ab-initio recursion method of studying electronic structure of alloys; field theoretic approach for quantum spin models; nano clusters of transition metals and noble metals; and metal insulator transitions in various transition metal oxides. In the experimental side, there are various measurements on nanomagnets in chains and clusters and vortex arrays; binary and ternary magnetic alloys; magnetic oxide nanoparticles and nanowires, magnetocaloric effects and multiferroics; and thin films and bulk smart materials like ferromagnetic shape memory alloys and optically active oxides are studied.

Department of Chemical, Biological and Macromolecular Sciences

The Department is active in the area of research of chemical and biological and condensed molecular and mesocopic systems. In biophysics area, various drug-DNA, and proteins in solvents are studied with the large scale use of Ultra Fast

Spectroscopy and through the theoretical modelling. Various solvent response properties are studied using statistical mechanical and simulation procedures along with the experiments of spectroscopy. Various molecular and mesoscopic systems in condensed phases are studied quantum mechanically and with the quantum statistical mechanical methods.

Ultra Fast Spectroscopy Laboratory – SNBNCBS

Department of Astrophysics & Cosmology

Significant research progress has been made in the following four areas:

(i) Accretion disks of black holes,

(ii) Cosmological dark matter and dark energy,

(iii) Quantum information theory,

(iv) Ionospheric studies.

The phenomenon of high energy radiation from propagating shock waves in accretion disks of black holes, known as quasi-periodic oscillations, has been studied in detail. Hydrodynamic simulations of sub-Keplerian accretion flows have been performed. QPO frequencies have been used to estimate the spin parameter. Monte-Carlo simulations of the thermal Comptonization process has been performed.

A mechanism that could be responsible for the present acceleration of the universe has been investigated using kinetic energy driven scalar field models (k-essence). Unified models of dark matter, dark energy and early inflation have been constructed. Their parameters are constrained through the analysis of CMBR and Supernovae observational data. Astrophysical constraints have been obtained on surviving primordial black holes in Brans-Dicke theories.

Demonstration of quantum information processing with single particle path-spin hybrid entangled states have been carried out. Protocols for entanglement swapping and information transfer have been developed using such states.

Very low frequency studies of the ionosphere has been launched by obtaining VLF signals from all over the country. A theoretical model being developed to understand the behavior of the signals has led to some interesting preliminary results on ionospheric anomalies due to seismic activities.

Publications

43 Papers by scientist working in the Department of Theoretical Sciences, 29 papers by those in Department of Material Sciences, 23 under the aegis of Department of Chemical, Biological, Macromolecular Sciences and 24 by scientists of Department of Astrophysics & Cosmology were published in various international & national journals.

An edited volume was published by AIP, NY. "Astrophysics and Cosmology after Gamow": Proceedings of the 4th Gamow International Conference on Astrophysics and Cosmology After Gamow and the 9th Gamow Summer School "Astronomy and Beyond: Astrophysics, Cosmology, Radio Astronomy, High Energy Physics and Astrobiology"Chakrabarti, Sandip K.;Zhuk, Alexander I.;Bisnovatyi-Kogan, Gennady S.2010 AIPC.1206.....C

Conferences Held

Sl	*Title of the Conference*	*Date*
01.	Physics of New Materials	16-18 Jan. 2010
02.	Magnetism, Superconductivity and Phase Transitions In Novel and Complex Materials : MSMO9 Meeting	11-14 Nov. 2009

03.	Workshop on Applications of Dual Beam Scanning Electron Microscope and Environmental Scanning Electron Microscope	08-09 Oct. 2009
04.	Introduction to Parallel Computing	06-08 Oct. 2009
05.	Very Low Frequency Radio Waves Frequency and Observation	14-18 Mar.2010

THE NATIONAL ACADEMY OF SCIENCES

During the 79th Annual Session of the National Academy of Sciences, India, a Symposium entitled "Science and Technology and the Young (Career, Creativity, Excitement)" was organized to inspire the young for taking science as their career. The Inaugural Session was held on 14 December 14 2009 at Kolkata and Special Address was delivered by Dr. (Mrs.) Manju Sharma while Prof. M.G.K. Menon while delivering the Inaugural Address. NASI-Reliance Industries Platinum Jubilee Awards for the year 2009 were also presented and 2 books on Darvin and one special issue of the proceedings of the NASI on Parasitology released. About 200 research papers were presented in the scientific sessions held during 79th Annual Session.

Science Communication Activities & National Science Day Celebration

Like previous years, the Academy organized science communication activities to stimulate the students for cultivation of scientific temperament and to opt science as a career. The activities organized during the year included workshop for the teachers, talent search, science extension lectures, science quiz, debate, oration, exhibition, scientific writing/painting contest, winter scahool and summer school.

Jal Chaupal

Saket Girl's Inter & Degree College, Pratapgarh taking a note of rising cases of water borne diseases, especially fluorosis and other related ailments in the area, requested NASI to organise a Jal Chaupal/ Workshop on Water Conservation, Purification and Training to make the people aware about the importance of safe water in their life and also to train them to test the water samples as well as purify by adopting simpler methods.

Science Extension Lectures

The Academy organized a teacher's workshop on Mathematics on 19-20 September 2009. 80 teachers from the intermediate colleges of UP, MP and Bihar participated in the workshop. The Academy, after receiving the extension for the DNA Club project from the DBT organized Vacation Training Programme and Summer School in June 2009. A four days winter schoolin February 2010 at Allahabad was also held. Several Science Communication Activities were also conducted at NASI to celebrate National Science Day 2010. A Symposium on "Self-reliance through Innovations in Science & Technology" - in commemoration of the 150th Birth Anniversary of Sir J. C. Bose was held on 2 May 2009 at National Institute of Plant Genome Research (NIPGR), New Delhi. Further, a two day Brain Storming Session on Safe Water for Rural and Urban India held at Allahabad on 9-10 July with World Health Organization

(WHO) support in collaboration with Sulabh International Academy of Environmental Sanitation (SIAES) followed by Allahabad Declaration

Publications of the Academy

The Academy published several scientific periodicals and other publications including Proceedings of the National Academy of Sciences, Section A, Physical Sciences- (Quarterly); Proceedings of the National Academy of Sciences, India, Section B, Biological Sciences - (Quarterly); Spl. Issue of the Proceedings of the National Academy of Sciences, India, Section B (Biological Sciences), 2009 on 'Parasitic Infections of Pharmaceutical and National Health Importance''; National Academy Science Letters- (Bi-monthly); Year Book 2010; Abstracts of Papers of Biological Sciences Section and Physical Sciences Section of 79th Annual Session.

Memorial Lectures, Awards & Fellowships

Academy organized Prof. R.N. Tandon Memorial Award Lecture in the National Institute of Plant Genome Research on 1 May 1 2009 besides Prof. Ranjan Memorial Award Lecture. Prof. B.K. Bachhawat Memorial Young Scientist Award Lecture (2008) was conferred on Dr. Saman Habib, Scientist, Molecular & Structural Biology, CDRI, Lucknow. Prof. R. N. Tandon Memorial Award Lecture (2008) was delivered by Prof. Pramod Tandon, Vice Chancellor, North-Eastern Hill University, Shillong on 17 July 2009. In addition, NASI- Senior Scientist Platinum Jubilee Fellowships (2010) have been awarded in Physical Sciences and Biological Sciences.

Dr. Saman Habib delivering the award lecture

Fellowship and Membership

The Academy has a total of 1511 Fellows including 29 Honorary Fellows and 82 Foreign Fellows. These include scientists from all disciplines of Science and Technology from India and abroad.

INDIAN NATIONAL SCIENCE ACADEMY

Hon'ble Prime Minister of India Dr. Manmohan Singh inaugurated the Platinum Jubilee year of the Academy on 10 January 2009 at a function held at the Indian Institute of Technology, Delhi. During the Platinum Jubilee Year, two new initiatives- Setting up of a Science Policy Study Cell and INSA Archive were enunciated by the Council.

Under the Inter Academy Programme on Science Education, INSA along with IASc., Bangalore and NASI, Allahabad together initiated programmes under (i) Summer Research Fellowships; (ii) Refresher Courses; (iii) Lecture workshops and (iv) Post-School Science Teaching Programmes.

Apart from release of routine INSA journals, the Academy brought out several special publications during the years which were released by Dr. APJ Abdul Kalam.

Capacity Building

With the aim of recognizing young scientists of extraordinary promise and creativity, the Academy instituted INSA Medal for Young Scientists since 1974. During the period, the Academy selected 28

young scientists for INSA medal for young scientists. The Academy has so far instituted 62 awards including 3 awards for Young scientists, to honour eminent scientists in different fields. This year 16 awards including 4 General Medal/ Lectures have been given.

Academy, under its science promotion activities, offered 13 superannuated Fellows Senior Scientists position. The Academy has raised the honorarium and contingency attached with the senior scientist to Rs.20000/- and contingency to Rs.50000/- per annum from 1st January 2008.

Centre for Co-operation in Science & Technology among Developing Societies (CCSTDS), Chennai is primarily engaged in developing major capacity building programmes for developing societies. The Centre functions under the auspices of INSA with grant primarily obtained from the DST with additional support from other S&T agencies. The CCSTDS has been active during this period continuing its activities regarding support to Indian scientists for participation in international conferences abroad, Fellowship given to scientists/ technologists from Developing Countries, science awareness programme for school children besides training of women scientists on patents.

For global scientific cooperation, INSA is the adhering organization in India to International Council for Science (ICSU) and its Unions to organize the following events: International Mathematical Union (IMU) General Assembly in Hyderabad in 2010; Committee on Space Research (COSPAR) General Assembly in Mysore in 2012; TWAS General Assembly, Hyderabad, October 2010; International Geographical Union (IGU) Regional conference in New Delhi in 2014.

Eight Indian Scientist are holding senior positions in ISCU bodies. Besides, around hundred are engaged in various committees/ commissions/ task forces of ICSU Unions.

Meeting of Science Academies of G8+5 Countries

The Indian National Science Academy participated in the Joint Academy Panel of the science academies of the G8 countries and five others (Brazil, China, India, Mexico, South Africa) organized by the Academia Nazionale dei Lincei held on 26-27 March 2009 in Rome. Fossil fuels being main sources of energy, the meeting discussed the science related issues required to address the concerns pertaining to greenhouse gas emissions. Joint Statement on Climate change and the Transformation of Energy Technologies for Low Carbon Future presented by the G8+5 Academies is accompanied by a document by the Network of African Science Academies (NASAC) entitled Brain Drain in Africa and released on 11 June 2009.

During the period, regular publication activities continued and Indian Journal of Pure and Applied Mathematics (IJPAM); Proceedings of Indian National Science Academy and Indian Journal of History of Science were brought out. The Academy has, since 1 January 2010 started co-publishing Indian Journal of Pure & Applied Mathematics with M/s.Springer India Pvt. Ltd.

During the period, 31 Indian scientists visited abroad under various bilateral exchange programme of INSA with the different Academies of the World. Fifteen foreign scientists visited different research institutes in India under the programme. The academy also provided 92 partial financial support to participate in various International conferences held under ICSY banner abroad.

Election of Fellows / Foreign Fellows

Thirty eminent Indian scientist and 5 overseas scientists were elected to the Fellowship and Foreign Fellowship of the Academy respectively during the year 2009 (effective from 1 January 2010).

Symposium on "Nutrition Security for Inda-Issues and Way Forward"

A symposium on *Nutrition Security for India -Issues and Way Forward* organized by INSA on 3-4 August 2009. The recommendations were released during concluding events of the Platinum Jubilee celebrations.

Planitum Jubilee Concluding function

- The concluding function of the Platinum Jubilee Year of the Academy was inaugurated by Her Excellency President of India, Smt. Pratibha Patil on 7 December 2009 at Saha Institute of Nuclear Physics, Kolkata.
- As a mark of Platinum Jubilee Ceremony three symposia and three special lecturers were held during 7-9 December 2009.
- During the concluding function of the Platinum Jubilee the Academy released following seven Special Platinum Jubilee Publications.
    - Compendium of Fellows of Indian National Science Academy (Volume I and Volume II)
    - Bright Sparks - Inspiring Indian scientists from the past by Dr. Arvind Gupta, IUCAA, Pune) was released by Shri Prithviraj Chavan, Hon'ble Minister of State (IC) for S&T and Earth Sciences
    - Platinum Jubilee of the Indian National Science Academy, Proceedings of the Inauguration
    - Special Issue of Indian Journal of Pure & Applied Mathematics
    - Future Directors of NMR edited by Professor CL Khetrapal & Professor Anil Kumar.
    - Astronomy edited by Professor T. Padmanabhan.

JAWAHARLAL NEHRU CENTRE FOR ADVANCED SCIENTIFIC RESEARCH

Jawaharlal Nehru Centre for Advanced Scientific Research, Bangalore was established in the year 1989, to commemorate the birth centenary year of Pandit Jawaharlal Nehru with the prime objectives of carrying out frontline research in selected thrust areas of science and engineering and to promote collaborative research with scientists at institutions in the country and abroad. The Centre carries out research in Chemistry and Physics of Materials Unit (CPMU), Engineering Mechanics Unit (EMU), Evolutionary and Organismal Biology Unit (EOBU), Geodynamics Unit (GDU), Molecular Biology and Genetics Unit (MBGU), New Chemistry Unit (NCU), Theoretical Sciences Unit (TSU) and International Centre for Materials Science (ICMS).

During the year, JNCASR has made rapid progress in all spheres of academic activities. An MS-Ph D in Chemistry and Biology has been started to facilitate the undergraduate students in their pursuit of research degrees. With 56 new students admitted, the total strength of the students stood at 183. The Centre awarded 27 degrees for PhD, MS (Engg.) and MS by research. Seven candidates from R & D institutions/ colleges have been offered Visiting Fellowships for 2009-10. The Summer Research Fellowship Programme (SRFP), the Project Oriented Chemical Education (POCE) and the Project Oriented Biological Education (POBE) programmes are progressing well. 7 candidates are working in premier institutions under the DST Postdoctoral Fellowship in Nano Science and Technology. The Faculty members published about 290 research papers in reputed international and national journals.

The Faculty of the Centre received many awards and distinctions. Prof. C N R Rao received the Queens' Royal Medal of Royal Society of London and August-Wilhelm-von-Hofmann Medal awarded by the German Chemical Society. Prof. M R S Rao has been honoured with the Padmashri Award by Government of India. Many Faculty members received recognitions like the Shanti Swarup Bhatnagar Award, National Bioscience Award, B M Birla Prize and Fellowships of the Science Academies.

At the CPMU, a new composite polymer (the new grapheme), the hardest and stronger than the strongest metal which has several commercial applications for building super capacitors has been unveiled. The faculty of MBGU, in collaboration with NIMHANS, discovered the gene responsible for causing hot water epilepsy at chromosome 10q21.3-q22.3, which is the first identification of a locus for this unusual neuro-behavioural disease. The faculty also found a link between acetylation of the histone chaperone NPM1 and manifestation of oral cancer to serve as a diagnostic marker for oral cancer progression and abnormal acetylation for a potential therapeutic target. EOBU researchers demonstrated for the first time in the world negative genetic correlations between developmental rate and larval feeding rate, evolution of clock properties under different day:night cycles showing the adaptive evolution of circadian clocks; endogenous nature of the egg laying rhythm in fruitflies and the role of moderate migration in promoting among-patch asynchrony, leading to stabilization of metapopulations.

The Centre for Computational Materials Science developed a new interatomic potential model for atomistic simulations of a room temperature ionic liquid, [bmim][PF6] based on results from ab initio MD simulations as well as physical property data from experiments.

ICMS established major scientific facilities like Ultra High Resolution Electron Microscope, Pulse Laser Deposition, Molecular Beam Epitaxy System, X-ray Diffractometer , FE-SEM, Technai, Plasma cleaners, Ion Millers and others. The ICMS signed MoUs with many leading Universities abroad and conducted two international winter schools and many seminars/ workshops. Two new research projects under ICMS have been started in collaboration with Purdue and North Western Universities with the support of IUSSTF, New Delhi.

Besides developing CD ROMs on Learning Science and Nanoworld, the Education Technology Unit and the C N R Hall of Science conducted various programmes to motivate school teachers and children towards science. These programmes include teachers training, lecture demonstrations, panel discussions, visit to various laboratories, interactions with scientists, etc.

Prof. C N R Rao delivered lectures to about 10000 students and teachers all over the country on Learning Science, Nanoworld and Celebration of Chemistry .

The Centre filed many international and national patents. Some of the inventions have been licensed and negotiations are in progress for licensing of other inventions. .

The Centre continued to expand its formal ties with other research organizations. A Coordination Agreement has been signed for a collaborative project under the Seventh Framework programme of the European Community for the project "Modeling of Nano- scaled Advanced Materials Intelligently (NONAMI). A Memorandum of Understanding (MoU) between Bhabha Atomic Research Centre (BARC) and JNCASR has been signed for the project for Development of Test Facility for different studies.

During the year, 28 Discussion Meetings/ Workshops were supported, about 80 seminars, 20 Fluid Dynamics Colloquia, 2 JNC Colloquia, 4 International Conferences/ Workshops/ Schools and 5 Endowment Lectures by eminent scientists were held.

INDIAN SCIENCE CONGRESS ASSOCIATION

The Indian Science Congress Association (ISCA), Kolkata is a premier scientific organization of the country established in 1914. ISCA has been promoting science and inculcating the spirit of science through its multifarious activities. ISCA meets in the first week of January in an Annual Congress of scientists, science administrators, policy makers and the general public to give a stronger impulse and a more systematic direction to the scientific inquiry, to promote the interaction of societies and individuals interested in science in different parts of the country and to obtain a more general attention to the objects of pure and applied sciences. ISCA brings together scientists both from India and abroad for mutual interaction in the cause of national development. Annual Congress of the Association has been held every year ever since 1914 with a very distinguished scientist as its General President.

The Association was formed with the objectives to advance and promote the cause of Science in India; to hold an Annual Congress at a suitable place in India; to publish proceedings, journals, transactions, etc. and to popularise Science. Since its foundation, the Association has steadfastly worked to uphold its lofty objectives.

Activities of ISCA Chapters

The Association started organizing popular science lectures in different centers in India from 1962-63. In the year 2009-2010 activities have been carried out in 22 ISCA Chapters which are at Allahabad, Amravati, Banasthali, Bangalore, Baroda, Bhopal, Bhubaneswar, Bodh-Gaya, Chennai, Coimbatore, Delhi, Guwahati, Hyderabad, Jaipur, Jammu, Kanpur, Karnal, Kolkata, Mumbai, Nagpur, Shillong and Visakhapatnam. The Chapters celebrated National Science Day, Engineers Day, Doctors Day, World Environment Day, Technology Day, etc and also organized different national seminars and awareness programme throughout the year.

Representation in Foreign Scientific Meeting

General Secretary (Outstation) ISCA represented ISCA in the 65th Session of American Association for the Advancement of Science (AAS) at San Diego, California during 18- 22 February 2010 while member Executive Committee represented ISCA in the 65th Session of Sri Lanka Association for the Advancement of Science (SLAAS) at Colombo during 7 - 11 December 2009.

Publications

Proceedings of the 95th Annual Session of the Indian Science Congress Association, Recommendations of 96th Indian Science Congress Association and Synopses of the Presentations of ISCA Young Scientist Awardees for 2008, and Abstracts of Young Scientists' Award Programme of the 96th Indian Science Congress were published. Four issues of the bi-monthly journal 'Everyman's Science' were also brought out.

97th Indian Science Congress

The 97th Indian Science Congress was held at Thiruvananthapuram under the auspices of the Kerala University during 3-7 January 2010. The Focal Theme of the Congress was *"Science & Technology Challenges of 21st Century - National Perspective"*. The session of addressed several thrust areas through plenary, symposia, panel and round table deliberations to make the world, in general and India, in particular a knowledge empowered society.

Focal Theme Sessions

Plenary lectures were on the themes: Science & Technology Challenges of 21st Century- National Perspective, Space Summit; Food and Nutritional Security; Current Issues on Biomedical Research Studies; Weather, Climate & Environment; Nanotechnology, and Education; Biotechnology; Biodiversity & Sustainable Development; Energy; Information Technology.

Besides the above, there was platinum jubilee lectures, endowment lectures, contributory papers, poster presentations and young scientist award competitions in 14 different sections viz. Agriculture and Forestry Sciences; Animal, Veterinary and Fishery Sciences; Anthropological and Behavioural Sciences (including Archaeology and Psychology & Educational Sciences and Military Sciences) ; Chemical Sciences; Earth System Sciences; Engineering Sciences; Environmental Sciences; Information and Communication Science & Technology (including Computer Sciences); Materials Science; Mathematical Sciences (including Statistics); Medical Sciences (including Physiology); New Biology (including Biochemistry, Biophysics & Molecular Biology and Biotechnology); Physical Sciences; and Plant Sciences. A series of special lectures and public lectures was organised.

Awardees

The following awardees were selected for 2009-2010. The awards were conferred to the respective recipients by Hon'ble Prime Minister of India, Dr. Monmohan Singh :

Asutosh Mookerjee Memorial Award	-	Dr.T. Ramasami, New Delhi
Srinivasa Ramanujan Birth Centenary Award	-	Dr.Rajinder Jeet Hans-Gill, Chandigarh
Jawaharlal Nehru Birth Centenary Awards	-	Dr.Montek Singh Ahluwalia, Delhi Dr.Sudha Nair, Chennai
M.N. Saha Birth Centenary Award	-	Prof.S.M.Chitre, Mumbai
P.C.Mahalanobis Birth Centenary Award	-	Prof.Manindra Agrawal, Kanpur
P.C.Ray Memorial Award	-	Dr.Ganesh Pandey, Pune
H.J.Bhabha Memorial Award	-	Dr.Anil Kumar, Pune
J.C.Bose Memorial Award	-	Prof.N.K.Gupta, Delhi
Vikram Sarabhai Memorial Award	-	Dr.K.Radhakrishnan, Trivan'rum
B.P.Pal Memorial Award	-	Dr.Lalji Singh, Hyderabad
Raj Kristo Dutt Memorial Award	-	Dr.V.S.Chauhan, New Delhi
Prof.R.C.Mehrotra Memorial Life Time Achievement Award	-	Prof.R.Ramamurthy, Tirupati
M.K.Singal Memorial Award	-	Prof.Satya Deo, Jabalpur
Millennium Plaques of Honour	-	Dr.R.Gadagkar, Bangalore Dr.D.Datta, Mumbai
Excellence in Science and Technology Award	-	Dr.Srikumar Banerjee, Mumbai

The following awards were also present during 97th Science Congress :

B.C.Guha Memorial Lecture	-	Dr.Malavika Vinodh kumar
Prof.Sushil Kumar Mukherjee Commemoration Lecture	-	Dr.A.K.Singh, New Delhi
Prof.S.S.Katiyar Endowment Lecture	-	Dr.Sudhir Sopory, New Delhi
Pran Vohra Award	-	Dr.Anirban Ray, Kolkata
Prof.K.P.Rode Memorial Lecture	-	Dr.Satyananda Acharya, Bhubaneswar
Prof.Hiralal Chakravarty Award	-	Dr.Gitanjali Yadav, New Delhi

Public Lectures were given by Dr APJ Abdul Kalam, Prof CNR Rao, Prof M G K Menon, Dr John C Mather, NL, Prof Roger Tsein, NL, Prof U R Rao and Prof Atul Gurtu.

The Science Congress was attended by about 7000 delegates from India and abroad including two Nobel laureates Dr John C Mather and Prof Roger Tsein from United States of America. About 2000 scientific and Technical papers were presented including those presented during 40 plenary sessions. In addition, Children's Science Congress was organised at the 97th Indian Science Congress which was attended by 3500 school children from all over India. A special session on Science Communicators Meet was also arranged. The Science and Technology Exhibition "Pride of India" organised on the occasion attracted about 2,50,000 visitors who were mainly students of different age groups.

INSTITUTE OF ADVANCED STUDY IN SCIENCE & TECHNOLOGY

Material Sciences Division

Observation of rarefactive ion acoustic wave in multi component dusty plasma

It has found that, in the present dusty plasma condition, applied rarefactive (negative) voltage pulse cannot break 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 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. Presence of dust introduces damping of ion acoustic wave and thereby modifies the balance between dispersion and nonlinearity. The Mach velocity and width of the solitary wave are also modified. However, the waves still maintain solitary wave characteristics.

Observation of near electron free plasma containing only negative ions and positive ions and study of sheath properties in a very low temperature plasma:

Production of very low temperature (~ 0.1 eV) and low density plasma and study of dust charging process in such plasma with the effect of external magnetic field have been investigated. Nearly electron free plasma containing only negative ions and positive ions has been produced and study of sheath properties in such plasma under well-controlled laboratory condition performed.

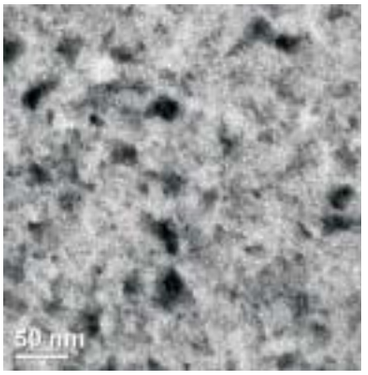
Dust charging in a low temperature and low density plasma produced using a magnetic filter

The charging mechanism of micron sized dust particles in very low temperature plasma in presence of magnetic field has been investigated. It has been observed that the average dust charge increases with the increase of magnetic field strength (10-100 Gauss). Such type of low temperature and low density plasma can be useful in study of lower ionospheric plasma and other basic plasma processes.

RF plasma polymerization process for surface modification of bell metal

Research work has been carried out for development of RF plasma polymerization technique for surface modification of bell metal which is commonly used in preparing idols, utensils and other decorative items. The work results in successful deposition of highly adherent, hard and scratch resistant polymer films (polystyrene and hexamethyldisiloxane) on bell metal substrates. Moreover these optically transparent polymer films exhibit stable chemical and thermal behaviors, thereby indicating that RF plasma polymerization can be a convenient and effective technique for surface protection of bell metal.

Synthesis of Organic-Inorganic Nanocomposite thin films by plasma based technique:



TEM image of Polyaniline/TiO_2 nanocomposite thin film deposited by plasma polymerization and magnetron sputtering combined process.

The applicability of PACVD process for synthesis of nanocomposite films of metal oxide/ conducting polymer has been investigated. Films have been deposited in a plasma CVD system and plasma parameters have been optimized for achieving the right condition for formation of nanocomposites. TiO_2/Polyaniline nanocomposite films of thickness 300 nm to 500 nm have been deposited under optimized condition with TiO_2 particle size of 3 nm to 5 nm as confirmed from TEM and XRD analyses. The composition of the deposited films has been studied using FT-IR. The optical properties of the deposited films are characterized with UV-Vis spectroscopy and Ellipsometry measurements. Electrical resistivity measured by four probe technique shows that nanocrystalline TiO_2/ Polyaniline film has a resistivity of ~10^2 ohm-cm, which is 7 and 10 orders lower than plasma prepared Polyaniline and TiO_2 respectively. This shows strong potential of application of TiO_2/ Polyaniline nanocomposite film for different types of device fabrication e.g Solar Cell and Sensor.

Synthesis of PCHMAS, PCHAS, PCHPES

Synthesis of Poly-sulfone of Cholesteryl methacrylate (PCHMAS), Cholesteryl acrylate (PCHAS), Cholesteryl 4-pentenoate (PCHPES) and its Co-poly-sulfone with n-hexene PCHMASH, PCHASH, PCHPESH have been completed and a proto type device as thermistor has been developed.

Monolayer self assembly of Patterned Organosilane study, Development of AFM based tip induced method for fabrication of templates for making polymer nanowire on self assembled monolayer.

Mathematical Sciences Division

Different classes of sequences single as well as double of crisp and fuzzy sets have been introduced and their different metric and algebraic properties have been investigated in detail. Also relationships between the introduced classes of sequences have been established. It includes the ideal convergence of sequences.

Queueing theory is a significant area of current research in the branch of Applied Stochastic Process. In this context, some important investigations have been made on different branches of queueing theory such as *Retrial models, Vacation models and Control of queues. Concepts of Bernoulli admission mechanism under two different retrial policies viz. classical retrial policy* and *linear retrial policy* are introduced for unreliable retrial model with two phases of service. Such types of models have potential applications in modern telecommunication systems and digital communication systems. Moreover, optimal management for the type of queuing system with two phases of service for unreliable server under has been designed.

Images pertaining to different modalities of breast and cervix cancer are being collected. The history regarding each patient is also being collected. The images are pathological, cytological and radiological images. At first, features regarding some pathological images have been discussed with the doctors and identified. Based on this some preliminary image processing (edge detection and shape analysis) has been done and shown to the doctors. The process of pattern recognition (which include fuzzification) is in progress.

As of now we have collected 450 units of data. And the blood samples, which had been refrigerated at 4^{o}C so that it remains intact, are now being processed in the AAS. Also the database has been created in SPSS and data entry of the collected data is being done.

Resource Management and Environment Division

A. The five lotic systems have been surveyed and the fishes identified. A total of 112 fish species have been recorded from all the landing sites. Some rare fishes have been recorded during the study period including new range extension of a number of species. Tenga watershed was surveyed and identification of fish fauna has been completed. Plantation in polluted oil field has been completed. This is the first ever field trial of Phytoremediation technique in the oil fields of Upper Assam.The technology was developed at IASST

Three Grass species viz., *Cyperus brevifolia, Cyperus rotundus and Axonopus compressus* were planted for phytoremediation ability for the cleanup of hydrocarbon-contaminated soil in field conditions. The plant showed effective results in reducing TPH. GC, TLC-FID revealed the significant degradation of saturates, aromatics and asphaltins by these plants. Significant changes were observed in the total petroleum hydrocarbon (TPH) content, soil nutrient status and the number of aerobic bacteria. *In vitro* bioremediation showed promising results in TPH degradation by native aerobic bacteria.

B. Remediation studies using petroleum hydrocarbon contaminated soil (artificially contaminated with crude oil of Assam) were conducted under different pH values and different NPK environments. From the detailed remediation (degradation measured with net loss of TPH) studies during six months of experimentation, there was significant degradation of petroleum hydrocarbons at pH 4.5 and 7.5. In general, soil responded most positively to pH increase from original pH to pH 7.5. It is observed that the degradation continued to improve with increase in concentration of NPK fertilizer. Soil responded most positively to 90% NPK fertilizer.

Life Science Division

The Institute is concentrating on the traditional/ folk medicine used against the liver ailments, Diabetes mellitus, hyperglycemia, inflammatory problems and Skin ailments using in vitro and in vivo models. Presently, a herbal formulation has been developed and its pre-clinical toxicity has been assessed against various animal models during this period. Antioxidant activities of certain indigenous fruits of the N. E. region studied and found very encouraging results. The four color morphs and wild counter part of muga silkworm (Antheraea assamensis) have been documented among the semi domesticated color morph and wild counterpart.

The scientists of the Institute published 33 papers in referred journals and many of them were honoured at various Conferences and by several agencies. They also delivered scores of lectures/ talks at several Conferences and Seminars. The Institute has 31 research scholars and during the year PhD was awarded to 3 scholars.

Ongoing Projects

i. "Investigation of collective processes in laboratory dusty plasma", sponsored by ISRO, GoI.

ii. "Basic experiments in multicomponent plasma with negative ions", sponsored by DST.

iii. "Development of RF Plasma polymerization process for deposition of hard transparent and corrosion resistant coating on Bell metal and surface modification of muga silk fibres" sponsored by DAE, GoI.

iv. "Studies on the discharge characteristics of pulsed plasma system for synthesis of conducting polymer films" sponsored by DST, GoI.

v. *"Development of Liquid Crystalline Polymer"* funded by MIT, DIT, GoI. *"Surface self-assembly @ constructive nanolithography enroute to polyaniline based nano devices"*, sponsored by DST, under SERC, Fast Track Scheme.

vi. "Study of 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.

vii. "Studies on Some Pattern Recognition and Machine Models with Application to Real Life Problems Related to Cancer Data and Development of Algorithms based on Pearsonian Systems of Curves", sponsored by DST.

viii. "Nutritional Status of the pregnant women in the low socio economic areas in Kamrup District" sponsored by CSO, MoSPI, GoI.

ix. "A study on Ichthyofaunal Diversity in five lotic ecosystems of Kamrup district, Assam and ecobiological study of two species of conservational importance" sponsored by NBFGR, Lucknow.

x. "Study of Aquatic biodiversity in selected watersheds of Arunachal Pradesh, India" sponsored by DST.

xi. "Field application of phyto and bioremediation technique for reducing oil contamination developed at IASST, Guwahati in collaboration with Oil India limited", sponsored by Oil India Limited, Duliajan.

xii. Development of Broad Spectrum remedy from Natural Sources for Healthcare with Special References to Skin Ailments DRDO, Ministry of Defence, GoI.

xiii. Plant-Diversity & Environment Education through Students of Assam, DST, GoI. "Evaluation of antioxidant property of some selected fruits of North East India - a biochemical approach", sponsored by DST.

xiv. "Evaluation of antioxidant property of some selected fruits of North East India - a biochemical approach", sponsored by DST, GoI.

xv. 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.

xvi. "Development of a package for seed production of muga silkworm", sponsored by, NABARD.

xvii. "Assessment of Impact of intake of aratificial colours through foodstaffs available in the North Eastern Region including Sikkim", sponsored by North Eastern Council.

xviii. "A systematic study on phisico-chemical properties of muga silk *(Antheraea assama)* fiber produced in India", DST.

xix. "Development of Grainage of muga silkworm using indoor rearing technique", sponsored by ASTEC, Govt. of Assam.

xx. "Rehabilitation of degraded soil of Upper Assam due to excessive mining of Coal", sponsored by Ministry of Environment and Forest, Govt. of India.

xxi. "Assessment of Impact of Anthropogenic Activities on Soil/ Water and Certain Medicinal Plants in and around Bharalu River", sponsored by Ministry of Environment & Forest, Govt. of India.

CENTRE FOR LIQUID CRYSTAL RESEARCH

Targeted research niches of Centre for Liquid Crystal Research (CLCR), Bangalore and its national significance/intended end-users is as follows:

Fast responding robust nematic liquid crystalline gels formed by a monodisperse dipeptide; electro-optic and rheological studies

CLCR has used a novel liquid crystalline mono-disperse homomeric dipeptide (GSC98) for creating the gel matrix with the nematic liquid crystal E7. The electro-optic and rheological measurements of liquid crystal gels formed by mixtures of these two showed that the gelation improves the dynamic characteristics of the electro-optic switching of the device employing these gels, by as much as two orders of magnitude. The property results in a robust fast responding liquid crystal display device.

Soft glass rheology in liquid crystal gels

Extensive rheological and thermal investigation has been carried out on varied concentration of the gelator (GSC98) in nematic liquid crystal E7, the concentration range being 0.2 wt% to 10 wt %. Among the several compositions of the gels studied, for certain concentrations, the calorimetric scans display a two-peak profile across the chiral nematic-isotropic (N*-I) transition, a feature reminiscent of the random-dilution to random-field crossover observed in liquid crystal gels formed with aerosol particles. All gels showed shear thinning behavior without a Newtonian plateau region at lower shear rates. Small deformation oscillatory data at lower frequencies exhibited a frequency dependence of the storage (G') and loss (G'') moduli that can be described by a weak power-law, characteristic of soft glassy rheological (SGR) systems. At higher frequencies, while lower concentration composites have a strong frequency

dependence with a trend for possible crossover from viscoelastic solid to viscoelastic-liquid behavior, the higher concentration gels, show frequency-independent rheograms of entirely elastic nature G'> G''.

Photoresponse properties of ZnO(101) based devices

The light detection property of the ZnO(101) film was studied by making hetero junctions of ZnO(101)/ Si with a native oxide, SiO_x buffer layer. ZnO/Si (111) diode showed strong rectifying behaviour characterized by the current-voltage (I-V) measurement under dark condition. It showed photoelectric effect under an illumination of incandescent light. High photocurrent was obtained for the crystal of (101) oriented ZnO.

Kinetics of *trans-cis* isomerization in azobenzene dimers

We have studied the kinetics of trans to cis isomerization under ultraviolet light, in the monolayer of dimer, bis-[5-(4'-n-dodecyloxybenzoyloxy)-2-(4''-methylphenylazo)phenyl] adipate, at an air-water interface. The trans to cis isomerization reaction of the molecules in the monolayer shows deviation from the first-order kinetics unlike those reported in azobenzene molecules. We attribute the deviation from first-order kinetics to the simultaneous photoisomerization of trans isomers to form cis isomers and the reverse thermal isomerization of cis isomers to form trans isomers.

Patterned electro-convective states in a bent-core nematic liquid crystal

These investigations focus on the anisotropic electro-hydrodynamic states arising in a highly conducting, planarly aligned, bent-core nematic liquid crystal driven by ac fields of frequency f in the range 10 Hz-1 MHz. The low f regime, wherein the primary bifurcation is to a state of periodic longitudinal stripes (LS), extends to an unprecedentedly large f, in the range 150 kHz–550 kHz, depending on the temperature T. This is followed by the high f regime wherein periodic normal stripes (NS) constitute the primary instability. Both the instabilities involve predominant inplane director modulations and streamlines normal to the wavevector. The current models of anisotropic convection based on static electrical parameters fail to account for the observed instabilities. (Figure).

Permittivity, conductivity, elasticity and viscosity measurements in the nematic phase of a bent-core liquid crystal

The study concerns measurements of electrical conductivity $\acute{o}$, dielectric permittivity $\mathring{a}$, elastic moduli k_{ii} and rotational viscosity $\tilde{a}$ in a bent core nematic liquid crystal. The parameter $\mathring{a}_{\|}$ shows two relaxations falling in the frequency bands 20-200 kHz and 0.9-2 MHz; $\mathring{a}_{\perp}$ also shows a relaxation between 0.9-5 MHz. The conductivity anisotropy $\acute{o}_a=\acute{o}_{\|}-\acute{o}_{\perp}$ is negative at low frequencies; it changes sign twice at frequencies f_1 and f_2 that increase with temperature, in the range 6.5-10 kHz and 95-600 kHz, respectively. Surprisingly, the splay modulus k_{11} is considerably greater than the bend modulus k_{33} in the entire nematic range; viscous relaxation is more complex than in calamitic systems involving at least a two-step process.

Unusual dielectric and electrical switching behaviour studies in the de Vries smectic A phase of two organosilaxone derivatives

Two organosiloxane derivatives exhibiting a smectic A (SmA) to smectic C* (SmC*) transition, with the SmA being of the de Vries type have been studied. In the SmC* phase the electrical switching and dielectric constant dependence on the DC bias field behavior are normal, showing a single peak. However, in the SmA phase the features are surprisingly different from that for a typical smectic A phase exhibiting electroclinic response. Immediately above the transition from the Sm-C* phase, the data exhibit a double peak profile, characteristic of an antiferroelectric switching.

Electric-field dictated phase diagram and accelerated dynamics of a reentrant nematic liquid crystal under photo-stimulation conditions

Experiments were carried out which combine two recent findings, namely, an applied electric field can accelerate the return to the nematic liquid crystalline phase from a photo-driven isotropic phase, and in a reentrant mesogenic system the photo-induced phase can be more ordered. Unique temperature-electric field phase diagrams mapped out for a liquid crystal exhibiting isotropic-nematic-smectic A-reentrant nematic sequence reveal that the electric field influences all the transitions, but its effect is maximum on the equilibrium re-entrant nematic to the photo-induced smectic A transformation.

Understanding the observation of large electrical conductivity in liquid crystal-carbon nanotube (CNT) composites

Employing electrical and magnetic fields as reorienting fields, it has been demonstrated that large magnitude of enhancement in the electrical conductivity reported in voltage-driven reorientation measurements is not due to the inherent property of CNTs, and that dielectric breakdown and local heating effects play an important role. The calculated magnitude of the local heating effect is in agreement with the experimental observations.

During the year, 35 papers were published in national & international publications having Cumulative Impact factor of 101.38 and Average Impact factor of 2.896. The Institute also produced 2 PhD in the year.

Specialized services offered

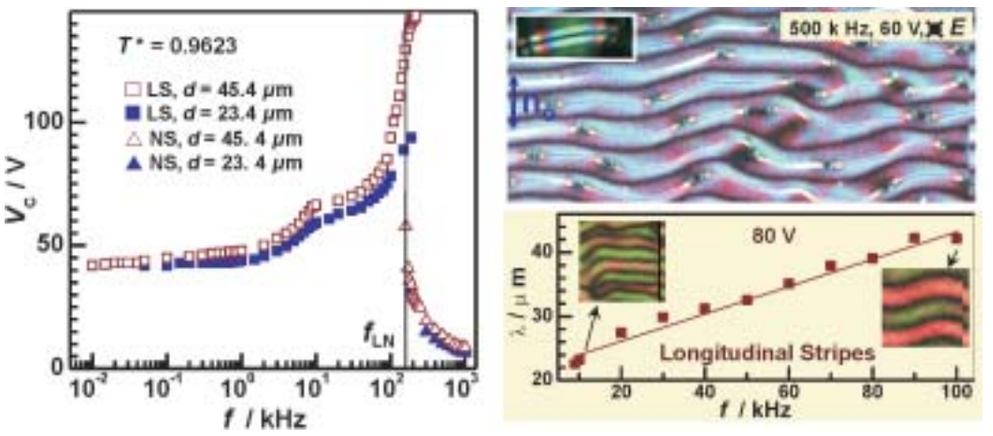
High Resolution Mass Spectrometer for molecular weight upto 6000 Dalton, Differential scanning calorimeter system with sub-ambient cooling assembly, Elemental Analyser for CHN analysis.

Total number of on-going collaborative research and technology development projects within India and with foreign partners

Three projects within India [SERC and CSIR project]

Three projects with foreign partners [Indo-Hungary, Indo-Bulgarian and Indo-Japan Projects]

Adjunct / Visiting Faculty / Research Staff affiliated to Institution or Research Program : One Scientist from Hungary and one Scientist from Japan visited the Centre.



Frequency dependence of the threshold V_c at which the sample undergoes the primary bifurcation. LS and NS denote longitudinal and normal stripes, respectively (Left). Loop defects in the NS state under crossed polarizers (Right, top); frequency variation of the LS periodicity (Right, bottom).

INDIAN INSTITUTE OF ASTROPHYSICS

The Indian Institute of Astrophysics was set up in April 1971. It is devoted to conduct training and research in the specialized area of Astronomy, Astrophysics, Physics and allied topics, develop astronomical instrumentation and disseminate the knowledge thus acquired. The main laboratories *viz.* photonics, electrical, electronics, mechanical workshops, theory groups, classrooms, administrative offices and Library are functioning in the headquarter campus at Bangalore. Its observational and experimental facilities are located at Kodaikanal (near Madurai), Kavalur (Vainu Bappu Observatory, near Jolarpet), Gauribidanur and Hosakote (near Bangalore) and Hanle (near Leh, Ladakh).

During the current year, several important scientific, teaching and other instrument development activities have taken place. Some of them are as follows:

- Various parts of the technologically complex project of fabrication of the Ultra Violet Imaging Telescope (UVIT) were developed and considerable progress has been achieved. This instrument will be a major payload on the first Indian astronomy space mission 'ASTROSAT';
- Elaborate preparations were made for design and development of precision instruments for the observations of the total solar eclipse of 22 July 2009. The Institute set up three campus: two in India and one in China. The preliminary results have been communicated to International Astronomical Journal for publication; more detailed analysis of the results are under preparation;
- Site characterization studies were being made at three locations in the Himalayas towards setting up a National Large Solar Telescope. Simultaneously, a detailed concept design report has been formulated by the consultants of the project, MT Mechatronics, Germany. The Institute is now preparing a detailed project report for submission to the Government with a view to establish the world's largest solar telescope in India;
- Preparatory arrangements are being made for the development of space coronagraph jointly with other national laboratories such as Physical Research Laboratory, Aryabhatta Research Institute for Observational Sciences and Indian Space Research Organization;
- The Institute launched a major concerted effort in training of young and motivated students to carry out research in the astronomical sciences. This effort has borne results in initiating two major Integrated Ph.D. and Ph.D. Programmes: one in Astrophysical Sciences as a joint venture with IGNOU, New Delhi and the other in Astronomical Instrumentation, jointly with the Calcutta University, Kolkata. In addition, Memorandum of Understanding has been signed with Pondicherry University and Jamia Miilia Islamia for further development of human resources. These efforts will generate a bank of quality human resources not merely to meet the requirements of IIA as also of other institutions/ university departments in the country;
- A state-of-the-art 1.3-m optical telescope is under fabrication at the DFM Inc, USA for installation at Vainu Bappu Observatory, Kavalur. A Differential Imaging Motion Monitor (DIMM), a 40 cm telescope supplied by DFM, was installed at Kavalur;
- The two national facilities at Kavalur and Hanle have been fully utilized for observations. The 7x7 HAGAR telescope system was fully commissioned;
- Efforts have been made to substantially increase the sensitivity of the Gauribidanur Radio Heliograph;

- Digitization of the 100 years of sun spot data has commenced at the Kodaikanal Observatory;
- The Institute conducted several Public outreach programmes as a part of the Year of Astronomy-2009;
- The Institute conducted and supported summer and winter schools in Astronomy and Astrophysics and relevant topics;
- Members of the Institute have published over 120 scientific papers in the leading national and international journals;
- Several members of the Institute have received recognitions and awards for their distinguished contributions to Astronomy and Astrophysics;
- The Institute continued to extend various welfare measures to staff members in accordance with the directives of the Government in reservation and in the implementation of the Official Language. A Gender Committee is also functional in the Institute.

INDIAN NATIONAL ACADEMY OF ENGINEERING

Indian National Academy of Engineering (INAE) is the apex body of distinguished engineers from all disciplines that also represents the country in the international Council of Academies of Engineering and Technological Sciences (CAETS).

INAE is a "Peer" body of the most distinguished engineers, engineer-scientists and technologists from the entire spectrum of engineering disciplines and its activities relate to programmes on issues of technical policy for overall development and benefit of the society, research projects, pilot studies, technical education, fellowships, scholarships, awards and other benefactions. The Academy has currently on its rolls 638 Fellows and 50 Foreign Fellows.

Activities, Schemes and Awards

Seminars/Conferences/Workshops

International Conference on "Research Policy for Sustainable Energy"

An International Conference on "Research Policy for Sustainable Energy" was organized by INAE during 12-13 Oct at New Delhi. Dr. R Chidambaram, Principal Scientific Advisor to the Govt. of India, while inaugurating the subject Conference emphasized that sustainable energy is crucial for survival of the planet due to emission and climate change concerns. Suitable energy technologies need to be developed specially geared to Indian conditions.

Dr. R Chidambaram, Principal Scientific Advisor to the Govt. of India delivering the inaugural address

Mr. Anil Razdan, Former Secretary (Power), Chairman of WEC-IMC, Mr. Surya P Sethi, Principal Advisor (Energy), Planning Commission, AG, Neubiberg, Germany; Dr. Ajay Mathur, DG, BEE; and Mr. Shyam Saran, Special Envoy to Prime Minister on Climate Change were among the key speakers. Mr. Martin Thomas from Australian Academy of Technological Sciences and Engineering and Prof. Jatin Nathwani, Waterloo Institute for Sustainable Energy, University of Waterloo, Canada gave brief presentations on Energy R&D.

Workshop on "Making India Powerhouse for Semiconductor Design"

Academy organized a Workshop on "Making India Powerhouse for Semiconductor Design" from 31 Oct to 1 Nov 2009 at New Delhi in collaboration with India Semiconductor Association (ISA) and supported by Ministry of Communication and Information Technology (MCIT) and Office of the Principal Scientific Advisor to Government of India.

The key recommendations emanating from the deliberations of the Workshop included promoting entrepreneurial spirits towards growing "Indian Companies"; easy access to fab for prototyping design ideas from university and R&D; establishing national-level semiconductor test and failure analysis facility; forming close-proximity clusters of universities and affiliated semiconductor industries; and executing specific programmes such as low-power design leading to next-generation products. Establishment of an appropriate coordinating organisation for these activities was also recommended.

Symposium on National Frontiers of Engineering (NatFOE)

The Fourth National Frontiers of Engineering (NatFOE4) was jointly organized by INAE and Indira Gandhi Centre for Atomic Research (IGCAR), Kalpakkam during 16-17 September 2009 at Kalpakkam. The themes selected for the NatFOE4 symposium were, Energy, Materials & Manufacturing, Structural Integrity, and Communication & Networking.

US-India Symposium on "Food Processing Technologies for Food Safety and Innovation

The Symposium was organized by CII, INAE and US NAE on 25-26 Feb. 2010 at Mumbai. The objectives of the symposium were to consider the role of food processing technologies to enhance food safety and drive innovation; to discuss approaches to establish the equivalency of new technologies and their safe commercialization; to provide a forum to address and discuss global and regional food safety issues and new approaches to food safety management and to deliberate on the importance of collaborative research in this field and the best models for supporting this approach.

Research Studies

The Academy undertakes studies on important/ topical national issues each year. The objective of such study is to prepare a comprehensive/exhaustive document covering review of existing international and national technological and commercial aspects, analysis of options, future trends and specific implementable policy/ recommendations and methodology of execution.

Engineering Education in India-Status, Concerns and Recommendations

A Study Group comprising of eminent experts in Engineering Education (Prof. KL Chopra, Prof. CS Jha, Prof. DV Singh and Prof. Gautam Biswas) had been constituted by the Academy. After detailed deliberations, a comprehensive report was prepared covering Historical Background; Characterization of Engineering Education with International Perspective; Challenges Faced by the Indian Engineering Education;

Ethics of Engineering Practices; Faculty Related Issues; Curricula; Improving Teaching/Learning Processes; Governance and Management Issues; Promotion of Research and Industrial Interaction; Technology Assisted learning; Innovation, IPR and Entrepreneurship; National Initiatives; Implications of Legal Judgments and Consolidated Recommendations.

This report has been published as a book entitled "Profile of Engineering Education in India-Status, Concerns and Recommendations' which was released by Shri Kapil Sibal, Hon'ble Minister of Human Resource Development on 222 January 2010 at New Delhi.

Technologies for Healthcare Sector in India

A Study Group has been constituted to investigate both existing and emerging technologies for the healthcare sector in India. The report will address state of healthcare in India; role of engineering in healthcare sector; identification of priority areas/ problems; technologies for healthcare sector; cost-effective technologies for the Indian market; equipment available in India including the limitations of the existing equipment; challenges that lie ahead and how the healthcare sector can be improved; and core recommendations.

Impact of Research on Chemical Industry – Current Status and Future Strategies

The aim of the Study is to enhance the relevance of basic and applied research to promote and strengthen industrial growth, innovation and competitive performance. This study will assess the impact of R&D on Indian Chemical Industry with specific reference to its profitability and global competitiveness; product diversification; fostering new entrepreneurs and start up ventures; quality and quantity of intellectual property generation; enhancing human resource capabilities and improving career paths of specialists; linkage with universities and R&D institutions; Government's R&D and innovation policies including promotion of incubation concepts and strengthening specialty chemical exports and Indo-overseas joint ventures.

Impact of R&D on Indian Mining Industry Performance – Identifying the new priorities and strategic initiatives

The aim of the Study is to assess the impact of R&D in the mineral sector; identify the performance shortfalls in terms of competitiveness, safety and environmental issues and address the challenges of the sector with aggressive R&D funding. For the purpose of this study, the Indian minerals sector will be segmented into coal and non-coal sectors and the past and current R&D initiatives will be assessed vis-à-vis their impact on industry performance and a new agenda of research priorities articulated.

Research Schemes/Programmes

With the objective to encourage invention, investigation, research and promote high caliber of engineering-scientists, INAE has instituted the following schemes:

INAE Chair Professorship

INAE Chair Professorship has been instituted in order to encourage engineers/ technologists with outstanding research contributions, promote long-term participation in academic research and enhance the research standards in academic institutions. INAE Fellows between the ages of 35 and 55 years, working in well-recognized teaching/research institutions in India are eligible for consideration.

INAE Distinguished Professors/Technologists

The objective of this Scheme is to utilize the expertise of INAE Fellows after superannuation primarily for research/ teaching in institutions/ universities/ Research & Development establishments, and industry in India. Superannuated Fellows below 70 years of age are eligible for consideration.

Mentoring of Engineering Teachers by Fellows of INAE

The objective of this scheme is the mentoring of Engineering Teachers by INAE Fellows. The period of mentoring is for any two months during the academic year. Motivated Engineering Teachers from recognized Engineering institutions are eligible under this scheme. Fifteen nominations have been selected during the year.

Mentoring of Engineering Students by Fellows of INAE

The objective of this scheme is the mentoring of bright B.E./B.Tech students by INAE Fellows. The period of mentoring is for any two months during the academic year. Meritorious 3rd /4th year B.E./B. Tech students from recognized Engineering institutions are eligible. Thirty six nominations have been selected during the year

Academia-Industry Interaction

AICTE-INAE Distinguished Visiting Professorship Scheme

The Scheme envisages promotion of industry-institute interaction by facilitating the dissemination of knowledge through the expertise of experienced and knowledgeable persons from industry to integrate their rich industrial experience with technical education. A total of 111 industry experts have been selected under the subject scheme which includes experts from industry as well as DRDO/DAE/DOS Labs. Eighteen nominees were selected for the current year.

International Affairs

18th CAETS Convocation

The 18th CAETS (International Council of Academies of Engineering and Technological Sciences) event of the current year was held on 13-17 July at Calgary and hosted by Canadian Academy of Engineering. An INAE Delegation attended this event. The Council Meeting of CAETS was also held on 17 July 2009. The highlight of the INAE Delegation's visit was the signing of MoUs between INAE and academies UK, Austraila, Canada and China on the sidelines of the CAETS event.

Annual Convention

The Annual Convention of the Indian National Academy of Engineering was held on 17-18 December 2009 at Kalpakkam. The major scientific and engineering highlights of the Convention were the technical presentations made by eighteen newly elected Fellows and ten Young Engineer Awardees. Dr. R Chidambaram, Principal Scientific Adviser to the Govt. of India & DAE Homi Bhabha Chair Professor, New Delhi and Mr. NR Narayana Murthy, Chairman of the Board and Chief Mentor, Infosys Technologies Ltd., Bangalore were conferred with Life Time Contribution Awards in Engineering 2009 and they delivered the award lectures. Besides this, Dr. VK Saraswat was conferred with Prof. Jai Krishna Memorial Award 2009 and Mr. Ashok Soota conferred with Prof. SN Mitra Memorial Award 2009. Eleven Young Engineers below the age of 35 years were presented INAE Young Engineer Award 2009 for excellence in design and technology transfer, innovative development and engineering research work.

CHAPTER 6

ADMINISTRATION AND FINANCE

RECRUITMENT CELL

Recruitment Cell in vested with the responsibility of making recruitment to Group 'A' and Group 'B' (Gazetted) Scientific and Technical posts as recruitment to these posts is exempted from the purview of UPSC. The recruitment to these posts is made by the method of direct recruitment or deputation (including short-term contract) or absorption as prescribed in the Recruitment Rules for the relevant posts.

Recruitment Cell is also vested with the responsibility of in-situ promotion of departmental Scientists under the Flexible Complementing Schemes (FCS) as contained in the Department of Science & Technology Group 'A' Gazetted posts (non-ministerial, scientific and technical) Rules, 2004. In situ promotions under FCS are considered twice before 1st January and 1st July every year.

Besides, Recruitment cell also deals with the proposals regarding recognition of Institutions/ Organizations under various Ministries/Departments as Scientific and Technical for the purpose of introduction of FCS.

During the year, recruitment has been made to three posts of Project Scientist 'D' and two posts of Project Scientist 'B' by Direct Recruitment purely on contract basis in the Nano Mission, SERC and one post each of Scientist 'B', Scientist 'C' and Scientist 'D' on direct recruitment basis in the Innovative Cluster Scheme in National Science and Technology Entrepreneurship Board on contract and co-terminus basis.

The assessment of eligible departmental Scientists for in-situ promotion under FCS review as on 01.07.2008 was also done.

STAFF POSITION

DST has a total number of 215 Group 'A' and Group 'B' (Gazetted) Officers. A detailed breakup is given below:

Group	General	SC	ST	OBC	PH	Total
Group 'A'						
Scientific	97	10	02	01	03	11
Non-Scientific	27	—	01	—	—	328
Group 'B'						
Scientific	09	02	02	—	—	13
Non-Scientific	47	09	05	—	—	61
Grand Total						215

Training Cell

Department of Science & Technology, in consultation with DoPT, other Scientific Departments and various organizations, embarked on an ambitious project of Human Resource Development namely "*National Programme for Training of Scientists and Technologists working in the Government sector*" for scientific and technical personnel during the X Plan to meet the challenges of national development and international competitiveness in S&T area. Considering the efficacy of the Scheme, the Department decided to continue it in XI Plan.

During the year 2009-10, 41 training programmes were held which include two training programme that got postponed in 2008-09 to 2009-10. These training programmes have been successfully conducted. Various topics covered under these programmes are as follows:

Administrative Staff College of India, Hyderabad	Scientific Project Formulation, Implementation and Evaluation (2 weeks), Advance Techno-management for Middle Level Scientists (5 weeks) Negotiating Strategies (2 weeks), Science Audit (1 week), General Management Programme for Senior Scientists (2 weeks), Decision Support Tools and Techniques for Senior Scientists (1 week), Technology Commercialisation (2 weeks), Science & Law (1 week), Innovation Management (1 week), E-procurement for S&T establishment (1 week)
National Institute of Advanced Studies, Bangalore	Senior Scientists' Multidisciplinary Perspectives on Science & Technology (2 weeks), Impact of Globlisation (1 week), Energy Security & Management
Lal Bahadur Shastri National Academy of Administration, Mussoorie	Science for Rural Societies Programme for Jr. & Middle level Scientists (2 Weeks), Scientists and Administrators interface training programme (1 week), Leadership Development Programme for Jr. & Middle level Scientists (1 Week), Incident and Emergency Management (1 week)
Indian Institute of Public Administration, New Delhi	Enabling Administrative personnel of S&T Departments (3 weeks), Cyber laws, Information Security and Computers for Administrative Personnel of S&T Deptt. (1 week), Foundation Training Programme for scientists (12 weeks), Advanced – Cyber laws, Information security and Computers for Scientists & Technologists (1 week), Natural Resource Management and Environment for Scientists & Technologists (1 week)
Indian Statistical Institute, Kolkata	Knowledge Discovery in Data Bases (1 week), Soft Computing (1 week)
Consumer Unity & Trust Society, Jaipur	IPR and related WTO issues, Technology Diplomacy
Centre for Cellular & Molecular Biology, Hyderabad	Bioinformatics – Current Trends and Perspectives
Indian School of Mines University, Dhanbad	Science & Economics of Rocks (A Primer on Mineral Economics) (1 week)
CBI Academy, Ghaziabad	Administrative Vigilance (1 week)

Under the Foreign Training Component, 30 senior scientists were deputed for one-week training in Israel during the current year.

Women Component Plan

Under women component plan '15' training programmes exclusively for women scientists were planned within the budget provision of Rs. 150.00 lakh. The training programmes were held on various topics as follows:.

Xavier Institute of Management, Bhubneswar	Communication and Presentation Skills (1 week), Financial Management and Audit Sensitization in Scientific Organizations
National Institute of Advanced Studies, Bangalore,	Dimensions of nano technology (1 week), Gender issues in S&T(1 week)
Indian Institute of Forest Management, Bhopal	Ethnic issues and community resource management (1 week)
Administrative Staff College of India, Hyderabad	Gender, Ethics and Law for Women Scientists (1week), General Management Programme (2 weeks), High Performing Team and Leadership Issues (1 week)
Indian Institute of Public Administration, New Delhi	Information Security and Advanced Computing for Support Staff of Scientific Organizations (1 week)
Academy of Human Excellence, Baroda	The Science of Living (1 week)
All Indian Institute of Medical Sciences, New Delhi	Research Methodology (1 week)
Wildlife Institute of India, Dehrudun	Biodiversity: Wildlife Conservation - Issues and Challenges (1 week)
M. S. Swaminathan Foundation, Chennai	Issues of Sustainable Development for Women Scientists (1 week)

HINDI SECTION

The Department of Science and Technology continued to make concerted efforts to promote the use of Hindi in official work and to ensure compliance with the provisions of the Official Language Act, 1963 as amended in 1967 and Rules 1976 framed thereunder as also the various orders/ instructions issued by the Department of Official Language from time to time with a view to ensure proper implementation of the Official Language Policy of the Government.

DST has a full–fledged Hindi Section consisting of a Joint Director (O.L.) assisted by an Assistant Director (O.L.) and other supporting staff which caters to the need of the Department and also its Subordinate

offices/ Autonomous Institutions. Besides monitoring the implementation of the Official Language Policy and the Annual Programme, Hindi Section arranges for in-service training of the staff in Hindi Language, Hindi Typewriting and Hindi Stenography. It also undertakes translation of the material received from various Sections/ Desks of the Department from English into Hindi and *vice versa*.

For promotion of the use of Hindi in this Department and to create conducive environment for the officials to work more in Hindi, various programmes are being undertaken:

- All documents coming under Section 3(3) of the official language Act, 1963 like general orders, notification, cabinet note, annual report and any paper which is to be laid in the parliament were issued bilingually in both Hindi and English. Letters received in Hindi were invariably replied to in Hindi.
- Departmental in-house magazine "*Tarang*" is published regularly with adequate priority to scientific and technical articles.
- With a view to encourage original scientific writing in Hindi, DST introduced "Dr. Meghnad Saha Award Scheme". Under the scheme, books written in the year 2006 were invited. 13 books have been received and 5 of them found suitable for final evaluation. Another advertisement is being issue for inviting the entries for this prestigious Awards for the year 2007 and 2008.
- The officers of Hindi Section conducted inspections of 12 Subordinate offices/ Autonomous Institutions and 6 sections of the Department regarding progressive use of Hindi.
- During the year, the second sub Committee of Parliament on Official Language carried out official language inspections of Indian Science Academy, Bangalore and Vigyan Prasar, Noida (U.P.).
- During the year, quarterly meetings of Departmental Official Language Implementation Committee were organized regularly. Likewise, four Hindi workshops were organized to encourage the officers/ staff of the Department to do their maximum work in Hindi.
- The Hindi *Salahkar Samiti* of Ministry of S&T is being reconstituted.

Cash Awards and Incentive Schemes

An incentive scheme to encourage officers and employees to do their maximum official work in Hindi is in vogue in the Ministry. Under the scheme, cash awards are given for doing noting and drafting in Hindi.

Celebration of Hindi *Pakhwara*

Hindi *Pakhwara* was organized from 14 to 24 September 2009 in the Ministry of Science and Technology. Various Hindi competitions were organized and the successful participants were given cash awards and certificates.

VIGILANCE UNIT

The Vigilance Unit in the Department of Science & Technology is headed by Chief Vigilance Officer, an Officer of the rank of Scientist 'G'. He is supported by an Under Secretary, Section Officer and other secretarial staff.

Apart from handling Vigilance related cases of the Department, its two sub-ordinate offices and 23 aided institutions, it deals with complaints, received from Central Vigilance Commission, Central Bureau of Investigation, Department of Personnel & Training and individual. Vigilance Unit also plans annually the

vigilance inspections of the institutes. During the current year, as per the approved plan, inspections of the following subordinate office and aided institutions have been carried out:

i) Agharkar Research Institute, Pune

ii) Aryabhatta Research Institute of Observational Sciences, Nainital

iii) Indian Institute of Astrophysics, Bangalore

iv) Geo-Spatial Data Centre, Survey of India, Bangalore

v) Science & Society Division, DST

vi) National Science & Technology Entrepreneurship Development Board (NSTEDB), DST

vii) Technology Development Board, New Delhi

viii) Indian Association for the Cultivation of Sciences, Kolkata

Vigilance Awareness Week was observed in the Department from 03rd to 07th Nov.,2009, wherein in addition to administering pledge to Officers and staff of DST & DSIR, a talks on 'Preventive Vigilance' was delivered by the Director, Central Vigilance Commission, New Delhi. An inter-active session between the officers/Scientists of various Divisions of the Department and representatives of various user agencies was organized to sensitize them about the problems faced by them while dealing with each other. (Photographs are enclosed)

An orientation workshop for Vigilance Officers of sub-ordinate offices and aided institutions under the Deptt. of Science & Technology was organized at CBI Academy, Ghaziabad from 30.11.2009 to 04.12.2009 under the Scheme "National Training Programme for Scientists/Technologists working as Vigilance Officers". Course Contents so framed to facilitate the part-time Vigilance Officers, who are basically from scientific background, to discharge their duties connected with Vigilance work smoothly.

Other miscellaneous activities, viz. identification of sensitive posts, rotational transfers thereon in the Department, appointment of Vigilance Officers and extension of their tenure, submission of periodical reports/returns on various vigilance activities to CVC, CBI, etc. are being done on regular basis.

AUDIT REPORT

A summary of Audit Observations pertaining to the Department of Science and Technology is enclosed, which has been made available by the office of C&AG, with the request to have it included in the Annual Report of DST for the year 2010-2011, to be presented in the forthcoming Budget Session of Parliament.

Sd/-

(Sanjay Pandey)
Controller of Accounts

Format

Sl.No.	Year	No. of Paras/PA Reports on which ATNs have been submitted to PAC after vetting by Audit	Details of the Paras/PA reports on which ATNs are pending		
			No. of ATNs not sent the Ministry even for the first time	No. of ATNs sent but returned with observations and Audit is awaiting their resubmission by the Ministry	No. of ATNs which have been finally vetted by audit but have not been submitted by the Ministry to PAC
1.	1 of 2006 – Union Govt			**1 (3.1 to 3.9)**	
2.	13 of 2007 (Scientific Departments), DST		**1 (5.3.1 to 5.3.8)**		
3.	CA 3 of 2008 (SD), DST			**1 (5.1)**	
4.	CA 3 of 2008 (SD), DST			**1 (5.2)**	
5.	CA 16 of 2009 (SD), DST		**1 (5.1)**		
6.	CA 16 of 2009 (SD), DST		**1 (5.2)**		
7.	CA 16 of 2009 (SD), DST		**1 (5.3)**		

DEPARTMENT OF SCIENCE AND TECHNOLOGY
SUMMARY OF FINANCIAL REQUIREMENTS

Sl. No.	HEAD OF DEVELOPMENT PROJECTS / PROGRAMMES / SCHEMES	ACTUALS 2008-2009			BE 2009-2010			RE 2009-2010			BE 2010-2011		
		Plan	Non-Plan	Total	Plan	Non-Plan	Total	Plan	Non-Plan	Total	Plan	Non-Plan	Total
1	2	3	4	5	6	7	8	9	10	11	12	13	14
	DEPARTMENT OF SCIENCE AND TECHNOLOGY	(Rs. in crores)											
1	SECRETARIAT ECONOMIC SERVICES												
1.1	SECRETARIAT, EXHIBITION & FAIRS & Pr. ACCOUNTS OFFICE	0.00	41.03	41.03	0.00	52.48	52.48	0.00	51.00	51.00	0.00	49.45	49.45
	TOTAL - SECRETARIAT ECONOMIC SERVICES	0.00	41.03	41.03	0.00	52.48	52.48	0.00	51.00	51.00	0.00	49.45	49.45
2	R&D SUPPORT												
2.1.1	MULTI-DISCIPLINARY RESEARCH IN SCIENCE & ENGINEERING (SERC)												
2.1.2	RESEARCH AND DEVELOPMENT SUPPORT	414.80	1.77	416.57	535.00	2.00	537.00	535.00	1.90	536.90	570.00	2.00	572.00
2.1.3	DRUGS AND PHARMACEUTICALS RESEARCH	96.40	0.00	96.40	96.00	0.00	96.00	78.00	0.00	78.00	50.00	0.00	50.00
2.1.4	NATIONAL MISSION ON NANO-SCIENCE & NANO-TECHNOLOGY	130.00	0.00	130.00	130.00	0.00	130.00	70.00	0.00	70.00	100.00	0.00	100.00
	TOTAL - R&D SUPPORT	641.20	1.77	642.97	761.00	2.00	763.00	683.00	1.90	684.90	720.00	2.00	722.00
	TOTAL - R&D PROMOTION PROGRAMMES	641.20	1.77	642.97	761.00	2.00	763.00	683.00	1.90	684.90	720.00	2.00	722.00
3	TECHNOLOGY DEVELOPMENT PROGRAMME	43.00	0.00	43.00	50.00	0.00	50.00	50.00	0.00	50.00	100.00	0.00	100.00
	TOTAL - TECHNOLOGY DEVELOPMENT PROGRAMME	43.00	0.00	43.00	50.00	0.00	50.00	50.00	0.00	50.00	100.00	0.00	100.00
4	TECHNOLOGY PROJECTS IN MISSION MODE												
4.1	TECHNOLOGY FOR BAMBOO PRODUCTS	20.00	0.00	20.00	40.00	0.00	40.00	30.00	0.00	30.00	25.00	0.00	25.00
	TOTAL - TECHNOLOGY PROJECTS IN MISSION MODE	20.00	0.00	20.00	40.00	0.00	40.00	30.00	0.00	30.00	25.00	0.00	25.00
5	S&T PROGRAMMES FOR SOCIO-ECONOMIC DEVELOPMENT												
5.1	SCIENCE AND SOCIETY PROGRAMME	12.00	0.00	12.00	12.00	0.00	12.00	8.00	0.00	8.00	8.00	0.00	8.00
5.2	SPECIAL COMPONENT PLAN FOR THE DEVELOPMENT OF												
	SCHEDULED CASTES	3.00	0.00	3.00	3.00	0.00	3.00	3.00	0.00	3.00	3.00	0.00	3.00
5.3	TRIBAL SUB PLAN	2.99	0.00	2.99	3.00	0.00	3.00	3.00	0.00	3.00	3.00	0.00	3.00
5.4	WOMEN COMPONENT PLAN	39.94	0.00	39.94	40.00	0.00	40.00	40.00	0.00	40.00	40.00	0.00	40.00
5.5	SCIENCE AND TECHNOLOGY ENTREPRENEURSHIP DEVELOPMENT												
	AND EMPLOYMENT GENERATION	28.12	0.00	28.12	35.00	0.00	35.00	40.00	0.00	40.00	40.00	0.00	40.00
5.6	SCIENCE AND TECHNOLOGY COMMUNICATION AND POPULARISATION	14.95	0.00	14.95	15.00	0.00	15.00	18.00	0.00	18.00	17.00	0.00	17.00
	TOTAL - S&T PROGRAMMES FOR SOCIO ECONOMIC DEVELOPMENT	101.00	0.00	101.00	108.00	0.00	108.00	112.00	0.00	112.00	111.00	0.00	111.00

DEPARTMENT OF SCIENCE AND TECHNOLOGY
SUMMARY OF FINANCIAL REQUIREMENTS

Sl. No.	HEAD OF DEVELOPMENT PROJECTS / PROGRAMMES / SCHEMES	ACTUALS 2008-2009			BE 2009-2010			RE 2009-2010			BE 2010-2011		
		Plan	Non-Plan	Total	Plan	Non-Plan	Total	Plan	Non-Plan	Total	Plan	Non-Plan	Total
1	2	3	4	5	6	7	8	9	10	11	12	13	14
	DEPARTMENT OF SCIENCE AND TECHNOLOGY			(Rs. in crores)									
6	INTERNATIONAL COOPERATION PROGRAMMES												
6.1	INDO-FRENCH CENTRE FOR THE PROMOTION OF ADVANCED												
	RESEARCH (IFCPAR)	10.00	0.00	10.00	10.00	0.00	10.00	10.00	0.00	10.00	10.00	0.00	10.00
6.2	SCIENCE COUNSELLORS ABROAD AND CONTRIBUTIONS	0.00	8.40	8.40	0.00	8.50	8.50	0.00	8.35	8.35	1.60	8.70	10.30
6.3	INDO-US SCIENCE AND TECHNOLOGY FORUM	3.35	0.00	3.35	4.00	0.00	4.00	4.00	0.00	4.00	4.00	0.00	4.00
6.4	S&T COOPERATION WITH OTHER COUNTRIES	35.38	0.00	35.38	36.00	0.00	36.00	36.00	0.00	36.00	34.40	0.00	34.40
	TOTAL - INTERNATIONAL COOPERATION PROGRAMMES	48.73	8.40	57.13	50.00	8.50	58.50	50.00	8.35	58.35	50.00	8.70	58.70
7	STATE SCIENCE AND TECHNOLOGY PROGRAMME	13.95	0.00	13.95	15.00	0.00	15.00	15.00	0.00	15.00	22.00	0.00	22.00
8	VOCATIONAL EMPLOYMENT GENERATION	1.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
9	TECHNOLOGY DEVELOPMENT BOARD	0.00	0.00	0.00	0.00	10.00	10.00	0.00	0.00	0.00	0.00	5.00	5.00
	TOTAL- OTHER SCIENTIFIC RESEARCH	868.88	10.17	879.05	1024.00	20.50	1044.50	940.00	10.25	950.25	1028.00	15.70	1043.70
10	SCIENTIFIC SURVEYS (MODERNISATION OF MAPPING ORGANIZATIONS (SoI & NATMO)												
10.1	SURVEY OF INDIA	23.45	225.47	248.92	13.05	255.07	268.12	7.96	283.53	291.49	13.05	253.93	266.98
10.2	NATIONAL ATLAS AND THEMATIC MAPPING ORGANISATION	1.92	10.78	12.70	2.95	16.60	19.55	1.54	14.22	15.76	2.95	13.42	16.37
	TOTAL - SCIENTIFIC SURVEYS	25.37	236.25	261.62	16.00	271.67	287.67	9.50	297.75	307.25	16.00	267.35	283.35
11	AUTONOMOUS SCIENTIFIC INSTITUTIONS	455.46	19.01	474.47	536.00	21.00	557.00	551.00	21.00	572.00	570.00	19.00	589.00
	TOTAL - SCIENTIFIC INSTITUTIONS	455.46	19.01	474.47	536.00	21.00	557.00	551.00	21.00	572.00	570.00	19.00	589.00
12	SYNERGY PROJECTS (O/o the PRINCIPAL SCIENTIFIC ADVISER)	16.00	0.00	16.00	20.00	0.00	20.00	20.00	0.00	20.00	20.00	0.00	20.00
	TOTAL	16.00	0.00	16.00	20.00	0.00	20.00	20.00	0.00	20.00	20.00	0.00	20.00
13	INFORMATION TECHNOLOGY	4.00	0.00	4.00	5.00	0.00	5.00	2.00	0.00	2.00	2.00	0.00	2.00
14	NATIONAL TRAINING PROGRAMME FOR SCIENTISTS & TECHNOLOGISTS	5.00	0.00	5.00	5.00	0.00	5.00	5.00	0.00	5.00	5.00	0.00	5.00
	TOTAL	9.00	0.00	9.00	10.00	0.00	10.00	7.00	0.00	7.00	7.00	0.00	7.00

DEPARTMENT OF SCIENCE AND TECHNOLOGY
SUMMARY OF FINANCIAL REQUIREMENTS

Sl. No.	HEAD OF DEVELOPMENT PROJECTS / PROGRAMMES / SCHEMES	ACTUALS 2008-2009			BE 2009-2010			RE 2009-2010			BE 2010-2011		
		Plan	Non-Plan	Total	Plan	Non-Plan	Total	Plan	Non-Plan	Total	Plan	Non-Plan	Total
1	2	3	4	5	6	7	8	9	10	11	12	13	14
DEPARTMENT OF SCIENCE AND TECHNOLOGY							(Rs. in crores)						
	NEW SCHEMES												
15	SCIENCE & ENGINEERING RESEARCH BOARD (INCLUDED IN Sl. No.2.1.2)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
16	SCHOLARSHIPS FOR SCIENCE IN HIGHER EDUCATION (OVERSIGHT COMMITTEE RECOMMENDATION)	84.96	0.00	84.96	40.00	0.00	40.00	26.50	0.00	26.50	40.00	0.00	40.00
17	WATER TECHNOLOGY INITIATIVE	4.96	0.00	4.96	15.00	0.00	15.00	6.00	0.00	6.00	60.00	0.00	60.00
18	INNOVATIONS IN SCIENCE PURSUIT FOR INSPIRED RESEARCH (INSPIRE)	40.37	0.00	40.37	60.00	0.00	60.00	78.50	0.00	78.50	240.00	0.00	240.00
19	INNOVATION CLUSTERS	4.92	0.00	4.92	7.00	0.00	7.00	7.00	0.00	7.00	7.00	0.00	7.00
20	SECURITY TECHNOLOGY INITIATIVE	2.50	0.00	2.50	7.00	0.00	7.00	7.00	0.00	7.00	7.00	0.00	7.00
21	MEGA FACILITIES FOR BASIC RESEARCH	5.00	0.00	5.00	40.00	0.00	40.00	20.00	0.00	20.00	30.00	0.00	30.00
	TOTAL	142.71	0.00	142.71	169.00	0.00	169.00	145.00	0.00	145.00	384.00	0.00	384.00
	GRAND TOTAL	1517.42	306.46	1823.88	1775.00	365.65	2140.65	1672.50	380.00	2052.50	2025.00	351.50	2376.50

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